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# The Welfare Cost of Inequality

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# The Welfare Cost of Inequality

*Preliminary draft*

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**Abstract**

Income inequality is a central topic for the social sciences. Work on it is often motivated by the idea that inequality implies some welfare loss. Yet, the *size* of this loss remains an open question. A definite answer would be crucial for economic policy-making. The goal of this paper is to show that the evidential foundations of this debate can be advanced with survey data on wellbeing. For this purpose, I utilise survey data from the *European Union Statistics on Income and Living Conditions (*EU-SILC; N≈750,000) to approximate the curvature of the income-to-wellbeing relationship. On that basis I then estimate the pecuniary cost of income inequality. I find that the annual cost of inequality is substantial. As a baseline estimate, and across 32 European countries, it currently amounts to about 14,000 Euros per capita. This is equivalent to just over 40% of mean European disposable household incomes. Since these calculations do not take into account any potential inefficiencies that may be induced by redistribution, I then analyse the permissible size of such inefficiencies, and estimate the conditions under which redistributive policy remains welfare-improving. Although covered by a wide range, the permissible size of inefficiencies induced by redistribution turns out to be surprisingly large, and can amount to between 20% and 70% of each redistributed Euro. Extensive sensitivity analyses of these results against alternative wellbeing measures, estimation methods, relative income effects, and the use of panel data are provided.

**Key words:** inequality, welfare, EU-SILC, subjective wellbeing, life satisfaction
**JEL Codes:** I38, I31, D63

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# 1 Introduction

Many think that current levels of income inequality are too high. They believe that social welfare would be greater if inequality were lower. Yet, few empirically estimate the welfare loss caused by inequality. Using self-reported wellbeing data to proxy for individual welfare, I here take up this challenge.

The wider societal effects of income inequality have, of course, been studied. Nolan and Valenzuela (2019) provide an overview: Income inequality is associated with more exploitative institutions (Savoia, Easaw, and McKay 2010), less political engagement (Solt 2008), a greater focus on national defence (Epp & Borghetto 2018), and less social mobility (Krueger 2012; Hertel and Groh-Samberg 2019). The effect of inequality on economic growth is likely negative, especially in the long-run (Banerjee and Duflo 2003; Halter, Oechslin, and Zweimüller 2014; Cingano 2014), and income redistribution appears to be uncorrelated with growth (Berg et al. 2018; OECD 2015). There also is a lively debate on whether income inequality worsens population health (Wagstaff 2000). While Pickett & Wilkinson (2015) forcefully argue that this is indeed the case, the economic literature has been more sceptical (O'Donnell et al. 2015; Deaton 2003).

Building on that work, this paper's fundamental idea is simple and well-known: As the level of income increases, its marginal utility declines. This concavity in the income-to-welfare relationship implies that total welfare is maximised when incomes are distributed equally. The more concave the relationship, the greater the loss from inequality. Therefore, to estimate the welfare loss from inequality, we need to estimate this curvature and combine it with data on the observed income distribution. Figure 1 illustrates the underlying intuition.

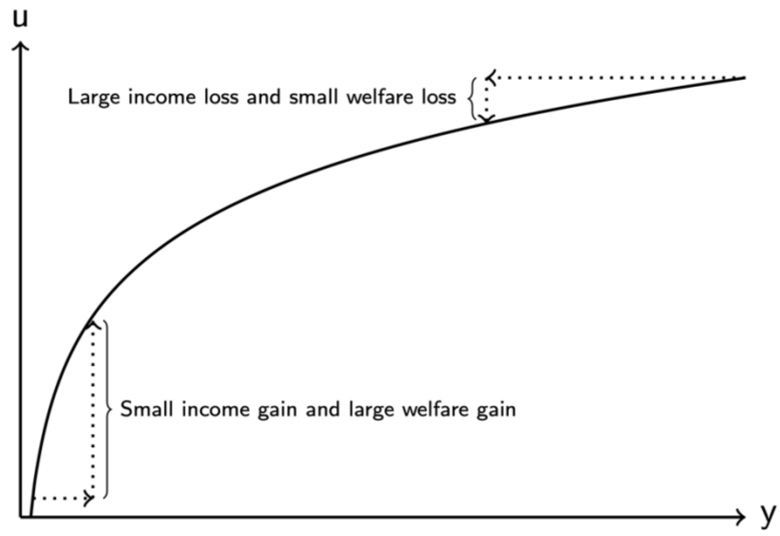
Prior to this paper, others have also studied the relationship between income inequality and self-reported wellbeing. Alesina, Di Tella, and MacCulloch (2004) is arguably the first[1] and most well-known study on this topic. They estimate regressions of individual-level happiness and life satisfaction on macro-level Gini coefficients. They find a negative association for Europe, but not for the US. Several subsequent papers then built on Alesina et al.'s general empirical strategy. These include Verme (2011), Oishi et al. (2011), Delhey and Dragolov (2014), Schröder (2016), Sommet et al. (2018), Katic and Ingram (2018), Reyes-García et al. (2019), Schneider (2019), and Liao (2021). Comprehensive reviews of that literature are given by Ferrer-i-Carbonell & Ramos (2014), Clark & D'Ambrosio (2015), Schneider (2016), and Ngamaba et al. (2018). These reviews broadly agree on four conclusions: First, in rich countries the association between wellbeing and inequality is negative. Second, in poor countries, this association is weaker and sometimes positive. Third, even among studies that look at similar sets of countries, estimates are relatively heterogeneous, indicating a lack of robustness to study design. Fourth, the causal mechanisms that drive these associations remain opaque.

To overcome these issues, I take a different approach. I flexibly estimate individual-level regressions of wellbeing on household incomes, and subsequently predict levels of wellbeing under various counterfactual income distributions. I do this for a large number of European countries.

This strategy has three advantages. First, macro-level studies of the kind discussed above effectively rely on small case numbers (i.e. $N \approx 100$). As shown in e.g. Bryan and Jenkins (2016)

[1] An unpublished extended abstract by Blanchflower & Oswald (2003), which reports on a small negative association between inequality and self-reported happiness in the USA, may be an even earlier example of this type of work.

**Figure 1. Illustration of why the curvature of the income-to-welfare relationship determines the welfare loss from inequality.**




**Note:** Welfare is represented on the vertical axis. Income is represented on the horizontal axis. When the level of income is large (small), the welfare loss from a given reduction (gain) in incomes is small (large). The greater the curvature of the relationship, the greater this effect.

estimates from multi-level models with relatively small $N$ are often biased and yield standard errors that are smaller than their nominal coverage. Moreover, a low macro-level $N$ limits the number of controls that can feasibly be included in such regressions. This tends to render estimates unstable (Verme 2011). Contrastingly, estimates of the individual-level welfare function are here based on hundreds of thousands observations from nationally representative samples.

Second, estimates of the individual relationship between income and welfare can be used to construct inequality indices that measure welfare losses in pecuniary terms. This enables me to build on the seminal contributions of Dalton (1920) and, especially, Atkinson (1970). One way of interpreting my pecuniary estimates of the welfare loss from inequality is to give an indication of the degree to which redistribution may be inefficient – in the sense of inducing a loss in average income – while still yielding a welfare gain.

Third, the approach permits calculating welfare losses for individual countries, and subgroups within them, at particular moments in time. This is unlike the macro-approach, where we, at most, obtain an average effect across heterogeneous sets of countries.

On top, much of this paper focuses on estimating the curvature of the income-to-wellbeing relationship. Apart from this being key to understanding the effects of inequality, such estimates are also important for other endeavours, including calculating optimal discount rates in public policy (Ramsey 1928; Evans 2005; Stern 2007) or informing the debates surrounding the Easterlin Paradox (Easterlin 1974; Stevenson and Wolfers 2013; Kaiser and Vendrik 2019; Easterlin and O'Connor 2020).[2]

[2] Which states that as countries grow richer over time, they do not grow more satisfied and happier.

As stated, the paper focuses on an individualistic channel – the curvature of the income-to-wellbeing relationship – through which inequality can harm mean wellbeing. Dwyer and Dunn (2022) recently made a similar kind of argument. They showed, using a global randomised control trial, that the marginal utility of income does in fact decline in respondents' income. On that basis, they argued that inequality reduces wellbeing. However, they did not estimate the exact curvature of this relationship. They also did not eventually calculate the wellbeing effects of inequality.

Most previous work has focused on alternative, primarily 'other-regarding', channels. These include social comparisons and a general aversion to inequality (Clark and D'Ambrosio 2015). Unfortunately, the extent to which inequality is welfare-decreasing due to these factors crucially depends on the choice of reference group (Hopkins 2008). The available data does not allow me to clearly identify the relevant reference groups. This makes reliable estimates of the importance of these channels difficult. In section 4.3, I will nevertheless present some estimations. These indicate that at least some of the welfare loss from inequality is indirectly driven by reference effects. But those results should be viewed as particularly tentative. My main focus therefore lies in exploring the welfare loss caused by the curvature of the individual income-to-wellbeing relationship. Given the presence of at least some unaccounted-for reference effects, we should interpret those results as a lower bound for the total welfare effect of inequality.

Two other limitations should also be noted at the outset. First, I do not explicitly model behavioural responses induced by redistributive policy. The canonical theoretical literature (e.g. Mirrlees 1971; Okun 1975; Saez, Slemrod, and Giertz 2012)) predicts that such behavioural responses should lead to a decrease in mean incomes. However, the empirical literature, as noted above, remains ambiguous on this question (Cingano 2014). In this paper, I side-step this important and ongoing debate. Instead, I simply estimate for a series of *types* of redistributive policy, and any *extent* of redistribution, how large such induced inefficiencies may at most be in order to continue to yield a net welfare gain. I take this kind of information to be particularly suitable to inform the current academic and policy-related debates. That said, work that integrates the approach taken here – i.e. estimating the shape of the utility function using survey data, and estimating the welfare loss of inequality on that basis – with ongoing work to model behaviour would seem like a fruitful avenue for future research.

A second limitation is that survey responses to wellbeing questions are treated as cardinal and interpersonally comparable measures. Although this is an almost universal assumption taken by work using such data, it has recently been questioned (Bond and Lang 2019; Kaiser and Oswald 2022). The data at hand does not allow me to probe interpersonal comparability[3]. However, I *can* relax the assumption of cardinality. I do so by re-estimating the curvature of the income-to-wellbeing relationship under several non-linear transformations of the scale with which wellbeing is reported (c.f. Kaiser and Vendrik 2022). Details and results of these tests, alongside with several other sensitivity analyses, are discussed in section 4.3.

[3] Using vignettes, i.e. wellbeing ratings of descriptions of fictional individuals, previous work has sort to probe the interpersonal comparability of survey data on wellbeing (Kapteyn, Smith, and Van Soest 2010; Montgomery 2022). Although this work does find some departures from comparability, these departures tend to be small.

The comparative *European Union Statistics on Income and Living Conditions* (EU-SILC) surveys serve as my main data source. The EU-SILC surveys provide high-quality information on incomes across 32 European countries. A unique advantage of these data is that they already serve as the official source for European statistics on the income distribution (Eurostat 2022). This allows me to get precise and widely agreed-upon inequality estimates for individual countries. As a surprisingly underexploited feature of the survey, the data includes information on respondents' life satisfaction, happiness and reporting to feel depressed. It also features a large sample size. Moreover, to examine the robustness of my results against controlling for time-invariant heterogeneity across individuals, I also use the German Socio-Economic Panel (SOEP).

My main results can be summarised as follows. First, the income-to-wellbeing relationship is much more concave than what is implied by the commonly adopted log-linear functional form. Disposable household incomes above approximately 70,000€ yield almost no further gains in life satisfaction. This finding is remarkably consistent across countries and contrasts with well-known results by Kahneman and Deaton (2010) and Killingsworth (2021), who do not find such a satiation point in life satisfaction data. Second, across Europe, the annual welfare loss due to inequality, as driven by the curvature of the individual income-to-wellbeing relationship, amounts to about 13,800€ in disposable household incomes. In relative terms, this is equivalent to an implied loss of 43% of mean disposable incomes. Third, in wellbeing terms the average loss equals roughly 0.16 points per capita on a 0-10 scale. Although seemingly modest, the size of this effect is five times as large as the welfare gain that could be obtained from eradicating unemployment. Fourth, half of the theoretically feasible welfare gains from reducing inequality can be obtained by levelling the incomes of the top 4% of the income distribution[4], or by a further hypothetical flat tax of 7% on disposable household incomes. Finally, although the results are qualitatively robust to the choice of wellbeing measure, choice of estimation method, and the use of panel data, the exact size of the estimated welfare cost of inequality does depend on these choices.

The next section will explain my empirical approach in more detail and will define the key quantities of interest. Section 3 outlines my data. Section 4 presents the main results, as well as several robustness tests and extensions. A final section concludes.

In what follows, I will be using the terms "welfare" and "wellbeing" interchangeably.

## 2 Empirical Approach

The paper's fundamental idea is to estimate the curvature of the income-to-wellbeing relationship, and to subsequently use these estimates for assessing the welfare loss from inequality. For that purpose I consider several variants of the following:

$$w_i = f(\theta, y_i) + \boldsymbol{\pi X_i} + \varepsilon_i \tag{1}$$

Here, $w_i$ represents self-reported levels of wellbeing for respondent $\boldsymbol{i}$. In the main, I will be using responses to the question "*Taking all things together, how satisfied are you with your life these days?*". Responses are recorded on a scale from 0 to 10. The vector $\boldsymbol{X_i}$ records a set of controls, a constant, as well as country- and year-fixed effects. $\boldsymbol{\pi}$ is a vector of associated coefficients. Throughout, I will primarily use OLS to estimate variants of equation (1). Estimations using ordered probit will

[4] By '<u>levelling</u> the top 4% of the income distribution' I mean that incomes are capped at the 96th percentile, and all incomes above that level are redistributed.

be shown, too. These yield almost the same results. I also show results that probe how sensitive my results are to the assumption that the choice of response option is linear in underlying wellbeing (c.f. the criticisms in Oswald 2008 and Kaiser and Oswald 2022). Of primary interest is the term $f(\theta, y_i)$, which represents the effects of income on wellbeing. Here, $y_i$ indicates respondents' disposable household incomes. $\theta$ is a vector of parameters. I expect $f$ to be positive monotonic and concave down. The degree of concavity – or, loosely speaking, the *curvature* of $f$ – will be a key determinant of the welfare cost of inequality.

Empirically, I consider four kinds of specifications for $f$. The first specification is to use the log of income, as is standard in the literature:

$$f(\theta, y_i) = \beta \ln(y_i) \tag{2}$$

Here, $\theta = \beta$. This specification *assumes* a certain degree of curvature of the income-to-welfare relationship, without estimating it. The second specification, which is also used by Layard, Mayraz, and Nickell (2008), and which is estimated by non-linear least squares overcomes this limitation:

$$f(\theta, y_i) = \beta \frac{y_i^{1-\rho} - 1}{1-\rho} \tag{3}$$

Here, $\theta = (\beta, \rho)$. Equation (2) is a special case of equation (3) since $\lim_{\rho \to 1} (y_i^{1-\rho} - 1)/(1-\rho) = \ln(y_i)$ The specifications of equations (2) and (3) are known as isoelastic utility functions, which have constant elasticity of welfare with respect to income (Groom and Maddison 2019).

In the sense that the curvature is entirely governed by a single parameter, specification (3) is also rather restrictive. In contrast, spline functions, which are connected polynomials within intervals of $y_i$, allow for much more flexibility with respect to the functional form of the income-to-wellbeing relationship. A particularly attractive option are *natural* splines, which impose continuity and smoothness[5] across intervals (Hastie et al. 2009). A specification in terms of natural splines can be written as (Stone and Koo 1985; Harrell 2015):

$$f(\theta, y_i) = \sum_{k=1}^{K} \beta_k y_{ki}^* \tag{4}$$

Here, $\theta = (\beta_1, \dots, \beta_K)$, $y_{1i}^* = y_i$, and $y_{k+1,i}^* = (y_i - t_k)_+^3 - [(y_i - t_{K-1})_+^3 (t_K - t_k) + (y_i - t_K)_+^3 (t_{K-1} - t_k)]/(t_K - t_{K-1})$, with $(u)_+ = \mathbb{1}(u > 0)u$. The terms $t_k$ are so-called "knots", and $K$ records the total number of knots. The location and number of these are chosen *a priori*. Natural splines allow the relationship between income and wellbeing to be a separate cubic between each pair of knots, allowing for a substantial amount of flexibility. For $y_i < t_1$ and $y_i > t_K$ natural splines can be shown to impose linearity (Harrell 2015). I set the number of knots $K$

[5] That is, constant second first and second derivatives when crossing intervals.

to $5$, and set $t_1$ to be at the 1st percentile of the observed distribution of household incomes, $t_2$ to the 10th percentile, $t_3$ to the 50th percentile, $t_4$ to the 90th percentile, and $t_5$ to the 99th percentile.[6]

Independently of the particular specification chosen, estimates of equation (1) can be used to compute the welfare loss from inequality. This welfare loss can be expressed in pecuniary terms (the '*shadow cost*') or in terms of points of wellbeing lost (the '*wellbeing loss*'). To make these computations, let average welfare be given by $W(\boldsymbol{y}) = N^{-1}\sum_i^N w_i\,(y_i)$, where $\boldsymbol{y} = (y_1, \dots, y_N)$ is a vector of all $N$ observed incomes. The wellbeing loss is then given by:

$$\Delta W \equiv W(\overline{\boldsymbol{y}}) - W(\boldsymbol{y}) \tag{5}$$

Here, $\overline{\boldsymbol{y}}$ is vector with each element equal to the average income. The quantity $\Delta W$ can be interpreted as the amount by which average wellbeing would be larger if incomes were equally distributed. It is possible to estimate the gain or loss in welfare from moving to any other counterfactual income distribution, too. This is explored in section 4.2.4

We are also interested in understanding the cost of inequality in pecuniary terms. For this purpose, we may define the *relative shadow cost* of inequality, by the value of a scalar $c$ which satisfies:

$$W(\overline{\boldsymbol{y}}) = W(c\boldsymbol{y}) \tag{6}$$

Here, $c$ can be interpreted as the amount by which each household income would have to be multiplied in order to attain the same welfare as could be attained under a perfectly equal income distribution with the same average income.[7] Multiplying all incomes by a constant is standardly thought to leave levels of inequality unaltered (Cowell 2009). This motivates this particular definition of the relative shadow cost. To get at the *absolute per capita shadow cost*, I compute $C \equiv N^{-1}\sum_i^N (c-1)y_i$. That absolute cost $C$ can be interpreted as the average amount (in Euros) by which household incomes would have to be raised.[8]

An important goal of research on economic inequality is to measure it. One key – and well-motivated – measure of inequality is the well-known inequality index of Atkinson (1970). Estimates of a version of this type of index will be shown in section 4.2.3. To motivate this exercise, it is useful to first show that there is an intimate connection between Atkinson's canonical index, and the *relative shadow cost* of inequality as defined above.

[6] To better illustrate the relationship between income and wellbeing in Figures 2 and 7, I additionally use a fourth type of specification. Specifically, I show results from a regression in which dummies for each percentile of the income distribution are entered. That is, I specify $f(\theta, y_i) = \sum_{q=1}^{100} \beta_q \mathbb{1}(t_q \geq y_i > t_{q-1})$, where $\theta = (\beta_1, \dots, \beta_{100})$, with $t_q$ denoting the $q^{\text{th}}$ percentile of the income distribution.

[7] To illustrate, if (say) $c = 1.1$, we would have to raise the incomes of all by 10% to obtain the same welfare as would be obtained in a counterfactual in which incomes were equally distributed at the observed mean.

[8] There are some potential alternatives to this definition. First, we could define the absolute per capita welfare loss to be that constant $\tilde{C}$ which satisfies $W(\overline{\boldsymbol{y}}) = W(\tilde{C}\boldsymbol{I} + \boldsymbol{y})$, where $I$ is a unit vector of length $N$. Second, we could define the absolute per capita welfare loss to be that value $\tilde{\tilde{C}} \equiv N^{-1}\sum_i^N (c_i - 1)y_i$, where $c_i$ are the individual elements of a vector $\boldsymbol{c}$ for which $W(\theta, \overline{\boldsymbol{y}}) = W(\theta, \boldsymbol{c}\boldsymbol{y})$ holds and which minimises $\tilde{\tilde{C}}$. Clearly, for any $\boldsymbol{y}$ and concave $f$, $C \geq \tilde{C} \geq \tilde{\tilde{C}}$. These alternative definitions would not leave the level of inequality in the counterfactual distribution unaltered. I therefore do not further explore these alternatives.

Specifically, suppose we assume an isoelastic function of the sort given in equation (3) as a representation of people's utility function. In that case, the relative shadow cost of inequality, $c$, is given by:

$$c = \left( \frac{\bar{y}^{1-\rho}}{N^{-1} \sum_i^N y_i^{1-\rho}} \right)^{\frac{1}{1-\rho}} \tag{7}$$

Using equation (7), we can then write:

$$1 - \frac{1}{c} = 1 - \frac{1}{\bar{y}} \left[ N^{-1} \sum_i^N y_i^{1-\rho} \right]^{\frac{1}{1-\rho}} = A \tag{8}$$

$A$ is Atkinson' (1970) inequality index. Hence, this famous inequality index and the *relative shadow cost* of inequality are tightly related. No such closed-form expressions are available if we instead assumed specification (4) as a potential representation of the people's utility. However, Atkinson more generally defines his inequality index as a special case of the family of indices given by:

$$\tilde{I} \equiv 1 - \frac{y_{ede}}{\bar{y}} \tag{9}$$

Here $y_{ede}$ is Atkinson's *welfare equivalent equally distributed income*, defined to be that level of income, which, when distributed equally, would yield the same welfare level as the observed income distribution. In other words, $y_{ede}$ satisfies $W(\boldsymbol{y}_{ede}) = W(\boldsymbol{y})$. To connect this to the relative shadow cost of inequality, first write $\boldsymbol{y}_{ede} = \tilde{c}\bar{\boldsymbol{y}}$ with $0 < \tilde{c} \leq 1$. It can then be easily derived that $c = 1/\tilde{c}$ for isoelastic utility functions. Although this identity does not hold for all utility functions, Equation (9) can nevertheless be combined with any concave utility function to yield an inequality index bounded between 0 and 1.[9] As noted above, estimates of that index are given in section 4.2.3

The quantity $\tilde{c} = 1 - \tilde{I}$ also has a useful interpretation: $\tilde{c}$ can be interpreted as the minimum fraction of total incomes that need to be retained in order for a perfectly equal income distribution to yield the same welfare level as the income distribution of the *status-quo*. In that sense, $\tilde{c}$ sets a lower bound on how 'leaky' a redistributive effort towards perfect equality may at most be. Put differently again, $\tilde{c}$ informs us about the share of current mean incomes that we can afford to lose when redistributing incomes. Notably however, redistributive efforts that do not aim at *perfect* equality may be even more leaky than indicated by the value of $\tilde{c}$. This is shown in section 4.2.4.

## 3 Data

Comparative data from the EU-SILC as the primary source of information. The EU-SILC is coordinated by the European Commission and uses in-person interviews. All EU member states, as well as the UK, Iceland, Norway, and Switzerland are included. 32 countries are observed. Samples are nationally representative. The EU-SILC is comprised of yearly cross-sectional waves.

[9] As an alternative inequality index, we could also compute $I \equiv 1 - 1/c$, which is again bounded between 0 and 1.

My primary income variable are *disposable household incomes*. These are incomes from all sources, minus taxes and social insurance contributions. Following EU-SILC guidance, I adjust all incomes to have purchasing parity across countries and deflate incomes to 2018 prices (Mack, Lange, and Ponomarenko 2020).[10] Unfortunately, despite seeking to be nationally representative, top-incomes are often under-represented in the EU-SILC. This underestimates the true extent of inequality (Hlasny and Verme 2018). In robustness tests, I therefore use a top-income adjusted income variable as detailed in Carranza, Morgan, and Nolan (2022).

In 2013 and 2018, the EU-SILC fielded a well-being module which included questions on life satisfaction, happiness, and feeling depressed. Concerning life satisfaction, respondents were asked *"Overall, how satisfied are you with your life in general?"*, with response options between 0 and 10. Extremes were labelled *"Not at all"* and *"Completely"*. Only 2% responded with *"Do not know"*, indicating that respondents mostly felt capable of answering this question. My main results are based on this data. Nevertheless, results concerning happiness and feeling depressed are discussed in section 4.3. As controls in equation (1) I include age(-squared;-cubed), education, area of residence (urban/rural), health, dummies for numbers of adults in the HH, dummies for numbers of children in the HH, employment status, gender, marital status, industry dummies, job hours, country-fixed effects (when pooling across countries), and year-fixed effects. Individual fixed effects are included in robustness tests using the German SOEP survey.

I have about 745,000 observations available. Descriptive statistics on key variables are shown in Appendix Table A1. Mean disposable household income is equal to 32,010€ (SD=29,029). Mean life satisfaction is 7.14 (SD=2.00).

## 4 Results

### 4.1 Estimates of the curvature

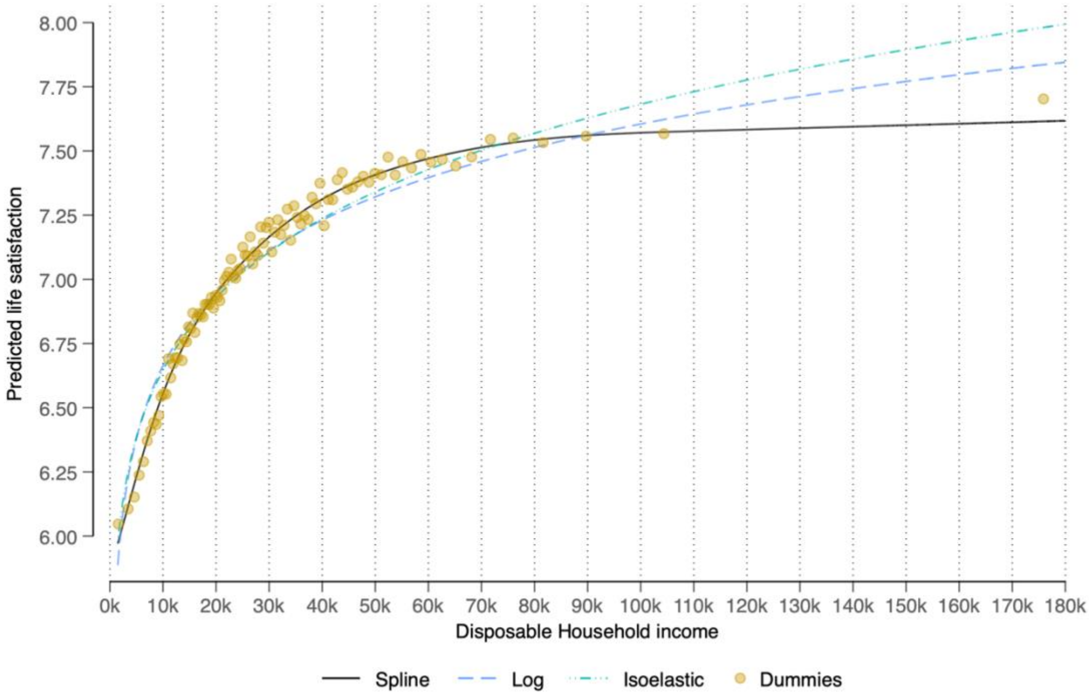
Figure 2 displays the first empirical result. Using pooled data from all 32 European countries, estimates of specifications (2)-(4), and results using dummies (see footnote 6) are shown. The full regression table is given in Table A2.

The blue dashed line shows the result from the log-specification of equation (2). The coefficient on the $\ln$ of household incomes is $\hat{\beta} = 0.409$. Hence, a doubling of household incomes can be expected to result in an $\ln(2)\hat{\beta} = \ln(2)0.409 = 0.283$-point increase in life satisfaction. This effect size is similar to earlier studies, including works with a focus on causal inference (Powdthavee 2010; Lindqvist, Östling, and Cesarini 2020). However, although the *scale* of this effect is estimated, its *curvature* is simply assumed.

The solid line in Figure 2 is not constrained in this way. That line is based on specification (4) and is thus a flexible estimate of both the scale and the curvature of the effect of household incomes. For household incomes above approximately €70,000 almost no further gains in life satisfaction occur. This is very different from the log-specification, which cannot detect such satiation. Consequently, for incomes above the €70k threshold, the log-specification and the spline-

[10] Since I control for the number of adults and children in the household, I did not additionally equivalise household incomes (c.f. Kaiser 2020, section 4.4).

**Figure 2. Pooled estimates of the income-to-wellbeing relationship**



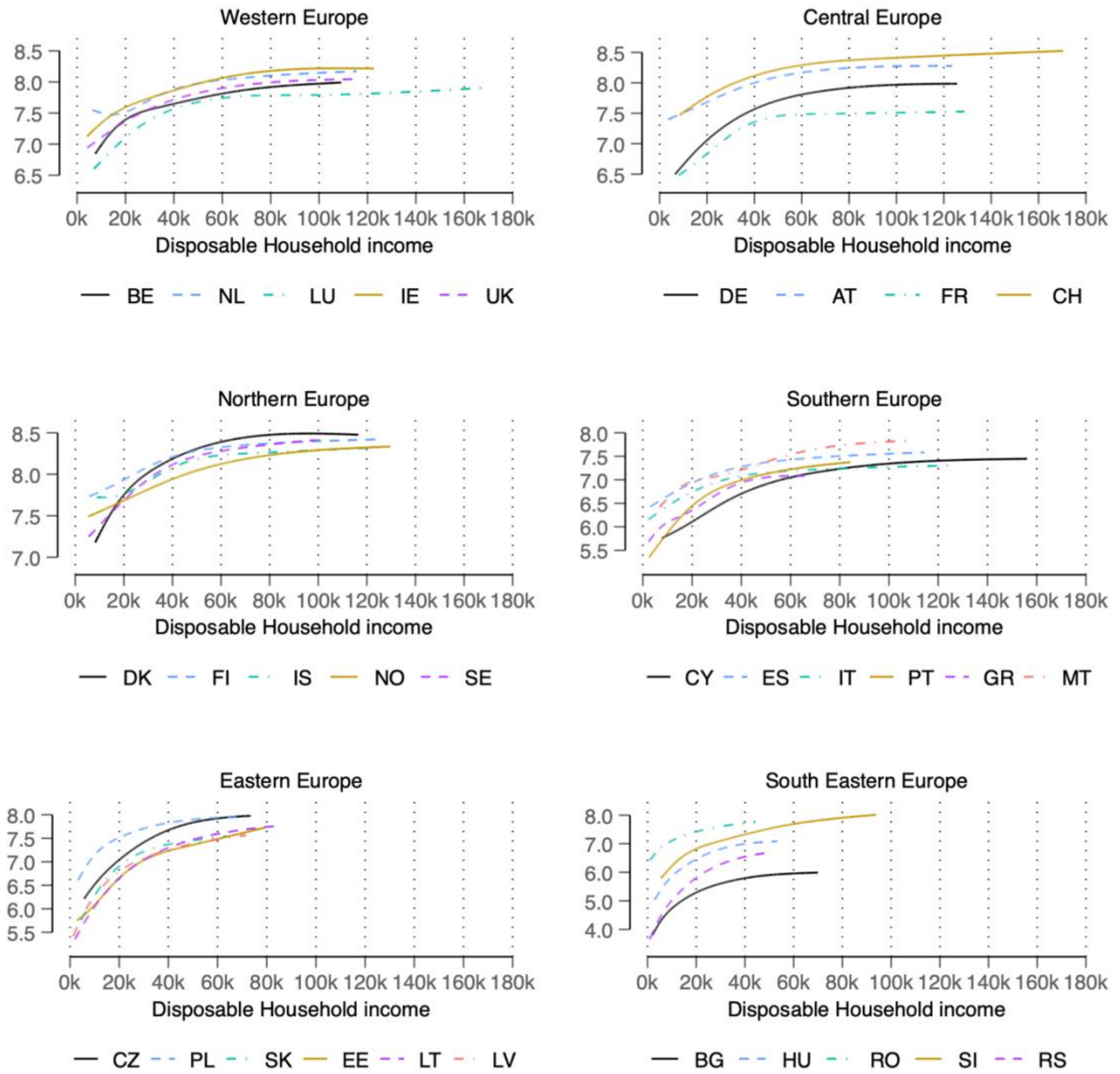

**Note:** The "spline" and "dummies" specifications, indicate that life satisfaction no longer increases for HH incomes above €70k. Contrastingly, the less flexible log and isoelastic specifications suggest increases in life satisfaction even beyond this point. Results are based on OLS regressions of life satisfaction on functions of disposable household income, a socio-economic controls (see page 8) which are set to their mean (mode) for continuous (categorical) variables, and year- and country-fixed effects. All incomes are PPP adjusted and deflated to 2018 prices. Data: pooled EU-SILC from 2013 and 2018; covering 32 countries.

specification yield very different results. For example, an income doubling from €70k to €140k is estimated to yield an 0.007-point increase in wellbeing in the spline specification, but the log specification (falsely) estimates an 0.283-point increase. That said, the two specifications perform similarly for relatively small incomes: The spline specification predicts a 0.245-point wellbeing increase from a €30k to €60k income doubling. The log-specification again estimates an 0.283-point increase for the same income change.

Finally, the broken line shows the results from a general isoelastic specification (c.f. equation (3)). Given the results from the splines specification, it is somewhat surprising that the $\rho$ parameter, which governs the curvature of the income-to-wellbeing relationship, is estimated to be below $1$. In particular, $\hat{\rho} = 0.9$, which indicates less curvature than the log specification. This estimate is also below the earlier finding of approximately $\hat{\rho} = 1.2$ obtained by Layard et al. (2008) across a wide set of countries. Given the marginally better fit of the splines specification ($R^2_{splines} = 0.230$) compared to the isoelastic- and log-specification ($R^2_{isoelastic} = 0.229$; $R^2_{log} = 0.228$) below I will primarily focus on the splines specification.[11]

[11] The isoelastic specification fit the data better than the log specification for small to medium incomes. This is why the isoelastic specification estimates a small curvature. Of course, the differences in $R^2$ are generally small. This is because little variation in life satisfaction is explained by household incomes in general.

**Figure 3. Individual-country estimates of the income-to-welfare relationship**




**Note:** Across the majority of countries, life satisfaction no longer increases for HH incomes above €70k (approx.). Results are based on country-specific OLS regressions of life satisfaction on splines of disposable household income, a set of controls (see page 8), and year-fixed effects. Predictions are truncated at the 99th percentile of the income distribution of each country. All incomes are PPP adjusted and deflated to 2018 prices. Data: EU-SILC.

In Figure 3, I replace the model which pools all countries with a separate model for each individual country. Two features of the figure are worth highlighting: First, the general shape of the estimated functions is strikingly similar across countries and European regions. We always observe a concave relationship that flattens out after some income level. Although there is some variation in that satiation threshold, a rough level of €70k as the point at which greater household incomes no longer increase satisfaction looks to be fairly universal across Europe. This may suggest that the PPP adjustment to correct for price differences across countries is reasonably accurate. Second, despite the similarity in approximate satiation points, there are differences in the estimated intercept. Since each regression controls for the same set of demographic and other socio-economic variables, the observed differences in intercepts are likely driven by wider cultural or institutional differences across countries.[12]

Although these estimates are primarily intended to inform the welfare calculations of the next section, they also speak to an important and ongoing debate on whether people get 'satiated' from greater incomes: Clearly, this is the case in my European data. Both when pooling across countries and when looking at each country individually, the effects of household income on wellbeing level-off precipitously. A figure of about €70,000 in household incomes appears to be the point at which incomes no longer make us more satisfied. This contrasts with well-known results by Kahneman and Deaton (2010) and Killingsworth (2021). Relying on US-American data, they find no evidence of satiation in life satisfaction data. Europeans and US-Americans may therefore fundamentally differ in their reactions to very high incomes. This is turn might explain wider differences between the two populations, e.g. including preferences with respect to working hours (Bick et al. 2019; Giattino et al. 2020), risk (Falk et al. 2018), or redistribution (Guillaud 2013).

## 4.2 Estimates of the welfare loss from inequality

The previous section estimated the curvature of the income-to-wellbeing relationship. On that basis, I will now discuss several ways in which the welfare loss from inequality in Europe can be quantified and put into context.

### *4.2.1 Europe as a whole*

Table 1 shows estimates of both the relative and absolute shadow cost of inequality, as well as estimates of the wellbeing loss. See Section 2 for details of how these calculations are made. Although I show results from both an isoelastic and a splines specification, I focus on the splines results because of their generally better fit with the data. Results from both pooled (corresponding to Figure 2) and country-specific (corresponding to Figure 3) specifications are shown.

As shown in column (1) of Table 1, the country-specific splines models indicate that the European relative shadow cost of inequality amounts to about 42% of disposable household incomes ($c = 1.419$). In absolute terms, this is equal to about $C \approx €13{,}400$ Euros. Hence, in order to reach the same wellbeing level as could be reached under an equal distribution, we would have to raise mean incomes by about 42% (while retaining the current level of inequality). When using the pooled splines model, which assumes a common functional form across all European countries, I obtain almost the same result.

Column (2) of Table 1 lists the mean shadow cost of inequality within each individual country. That is, I here estimate $c$ for each country individually, and then list the population-weighted mean across these values for $c$. These estimates – call them $\bar{c}_w$ – indicate the average relative cost of inequality if we could only equalise incomes within each country. These values are naturally lower than the total shadow cost of inequality $c$. This is because $\bar{c}_w$ ignores any between–country inequality. In order to find the additional relative shadow cost from between-country inequality, I

[12] Such differences may include the size and generosity of the welfare state. This is suggested by the fact that the traditionally most welfarist countries, i.e. those in Northern Europe, show the greatest wellbeing level for a given income (c.f. Easterlin and O'Connor 2022).

**Table 1. Estimates of the welfare cost of inequality**

| | Pecuniary shadow cost | | | Wellbeing loss | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | $c$ ($C$) | $\bar{c}_w$ ($\bar{C}_w$) | $c_b$ ($C_b$) | $\Delta W$ | $\Delta \bar{W}_w$ |
| Pooled Isoelastic | 1.259 (€8,293) | 1.217 (€6,842) | 1.035 (€1,080) | 0.102 | 0.087 |
| Country-specific Isoelastic | 1.307 (€9,163) | 1.253 (€8,012) | 1.055 (€1,419) | 0.126 | 0.091 |
| Pooled splines | 1.434 (€13,892) | 1.357 (€11,830) | 1.062 (€2,718) | 0.160 | 0.135 |
| Country-specific splines | 1.419 (€13,412) | 1.336 (€11,112) | 1.074 (€2,369) | 0.169 | 0.136 |

**Note:** Pooled specifications are all weighted by population size. $\bar{C}_w = \sum_j^J N^{-1} \sum_i^{N_j} (c_{wj} - 1) y_i$, where $N_j$ and $c_{wj}$ are, respectively, the population size and relative cost of inequality of country $j$. In words, $\bar{C}_w$ gives the population-weighted average of the country-specific absolute shadow cost of inequality. The absolute between-country cost of inequality is here defined to be $C_b = \sum_j^J N^{-1} \sum_i^{N_j} (c_b - 1) c_{wj} y_i$. Data: EU-SILC.

compute that value $c_b$ which satisfies $W(c\boldsymbol{y}) = W(c_b \boldsymbol{c_w} \boldsymbol{y})$. Here, $\boldsymbol{c_w}$ is a vector of within-country costs of inequality.[13] Comparing the estimates in columns (2) and (3), we see that, across all specifications, $\bar{c}_w$ is much larger than $c_b$. Hence, most of the shadow cost of inequality in Europe appears to stem from within–country inequality.

The absolute wellbeing loss from inequality is shown in columns (4)-(5). The estimate for $\Delta W$ indicates that a perfectly equal distribution of incomes across Europe would be associated with a $0.16$ points higher level of life satisfaction (on a 0-10 scale). Although this may seem small, recall, first, that the estimated effect of moving from €30k to 60k is approximately equal to 0.245. Hence, the total welfare loss from inequality is about two thirds as large as such an income doubling. Second, notice that $\Delta W$ indicates the average wellbeing effect on all European citizens. In contrast, many other wellbeing-relevant variables only affect a small portion of the total population. To illustrate, Table 2 shows – for each of the specifications also displayed in Table 1 – estimated coefficients associated with unemployment (compared to full-time employment) and divorce (compared to marriage). The table also shows the share of individuals affected by unemployment ($\approx 6\%$) and divorce ($\approx 8\%$). To approximate the total effect of eradicating unemployment and divorce on mean wellbeing we need to multiply the estimated coefficients with the share affected. The columns under the header $\Delta W$ show the results from this exercise. We see that the total wellbeing losses from inequality are about three to five times larger than the welfare losses from unemployment and divorce. In that sense, income inequality appears to be a major social ill.

All the above conclusions are qualitatively unaffected when examining any of the alternative specifications shown in Tables 1 and 2. Throughout, the largest part of the welfare loss is driven by within-country rather than between country-inequality. The pooled isoelastic specification yields the smallest estimated welfare loss. Given the low amount of curvature shown in Figure 1 this is unsurprising. No matter the specification, the welfare loss from inequality always exceeds those from unemployment and the incidence of divorce.

[13] That is, $\boldsymbol{c_w} = (\boldsymbol{c_{w1}}, \ldots, \boldsymbol{c_{wj}}, \ldots, \boldsymbol{c_{wJ}})$, where $j$ indexes the $J$ countries in the sample and $\boldsymbol{c_{wj}} = c_{wj} \boldsymbol{I_j}$, where $\boldsymbol{I_j}$ is a unit vector of length equal to the number of observations for each country (assuming, for simplicity, no sampling weights and that the country-specific number of observations is proportional to population size). As an alternative definition of the between-country cost of inequality $c_b$, one could also first equalise incomes within each country and then compute $c_b$ for this new vector of incomes. In the case of isoelastic utility functions, this alternative approach would yield the same result as the definition of $c_b$ given in the main text. However, this is not the case for concave utility functions in general. For related discussion, see Blackorby, Donaldson, and Auersperg (1981).

**Table 2. Comparison of the welfare loss from unemployment and divorce with the loss from inequality**

| | Unemployment | | | Divorce | | | Income inequality |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| | $\hat{\beta}$ | $\%\ share$ | $\Delta W$ | $\hat{\beta}$ | $\%\ share$ | $\Delta W$ | $\Delta W$ |
| Pooled Isoelastic | -0.509 | 6.22 | **0.032** | -0.580 | 8.00 | **0.037** | **0.102** |
| Country-specific Isoelastic | -0.532 | 6.22 | **0.024** | -0.484 | 8.00 | **0.036** | **0.126** |
| Pooled splines | -0.477 | 6.22 | **0.030** | -0.456 | 8.00 | **0.036** | **0.160** |
| Country-specific splines | -0.501 | 6.22 | **0.023** | -0.467 | 8.00 | **0.035** | **0.169** |

**Note:** The rows for the country-specific estimates (i.e. rows 2 and 4) give the population-weighted averages of the estimated $\hat{\beta}$ in each country. For unemployment and divorce, $\Delta W = (-\hat{\beta} * \%\ share)/100$, where $\hat{\beta}$ and $\%\ share$ are country-specific. For income inequality, $\Delta W$ is taken from the 4th column of Table 1. We see that the welfare loss from income inequality is largest across all specifications. Data: EU-SILC.

### *4.2.2 Cross-country differences*

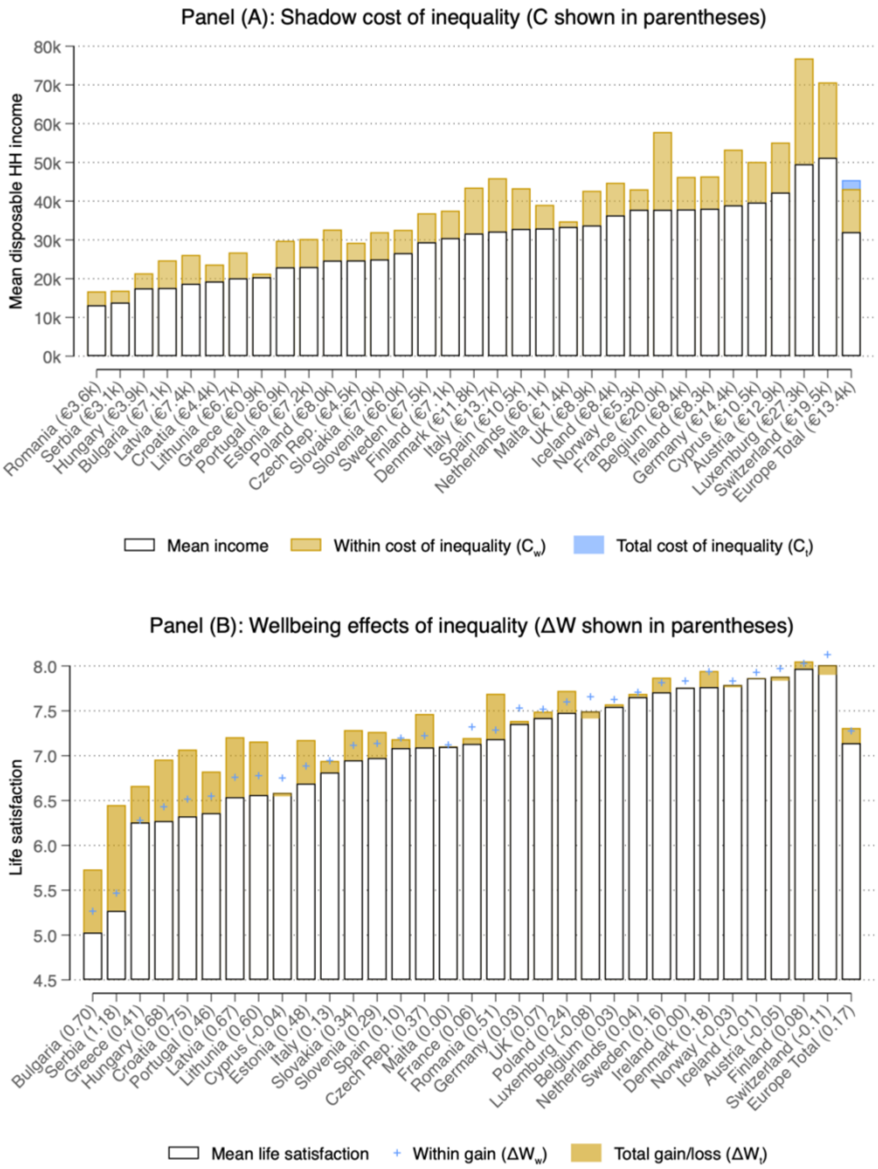
Above, I focused on the broad conclusions that can be reached regarding Europe as a whole. Cross-country heterogeneities are now illustrated in Figure 4.[14] There, estimates of $\Delta W$, $c$, and $C$ are shown for each individual country. County-specific splines specifications here serve as the underlying model. Figure A1 shows the equivalent, and substantively similar, results using the pooled splines model (i.e. where the same model is used across all countries).

**Shadow cost and wellbeing loss from inequality:** Panel A of Figure 4 shows estimates of the shadow cost of inequality for each European country. Take Italy and Sweden as examples. Although both countries have about the same mean income level, Italy is much more unequal than Sweden. Given that both country's income-to-wellbeing relationship is similar (see Figure 3), the shadow cost of inequality is almost twice as large for Italy ($C = €13{,}700$) as for Sweden ($C = €7{,}500$). Taking a broader perspective, the largest shadow cost of inequality can be observed in Luxembourg ($C = €27{,}300$). and the smallest relative cost is observed for Greece ($C = €900$).

Panel B of Figure 4 expresses the loss from income inequality in wellbeing terms. The blue dots show the losses arising from within-country inequality, only. The largest such loss is seen in Lithuania ($\Delta W = 0.350$), and the smallest in France ($\Delta W$ =0.011). The shaded bars show gains and losses in wellbeing that are predicted when also equalising incomes across countries, i.e. when equalising incomes across all of Europe. Most European countries' average wellbeing would be predicted to increase as consequence of equalisation. For some particularly poor European countries, such as Bulgaria or Serbia, the wellbeing gains would be especially substantial, i.e., more than 0.7 points on the 0-10 scale.

[14] Figure 4 make it difficult to see how the shadow cost and wellbeing loss of inequality are associated with each country's income dispersion and mean income. Figure A2 visualises these associations in a set of scatterplots. From these we see, as is intuitive, that a country's level of inequality (here measured by the Gini), and the associated welfare loss are correlated. In contrast, countries' mean income levels is not associated with the inequality-welfare loss.

**Figure 4. Country-level estimates of the welfare loss from inequality.**




**Note:** Panel (A) shows the absolute shadow cost of inequality, expressed in the average per capita € needed to reach the same welfare level as would be attainable under equality (see section 2 for the formulas). It is visible that the absolute shadow cost of inequality tends to be greater for richer and more unequal countries, though not uniformly so. The number displayed in parentheses next to each country indicates the within-country absolute shadow cost $C_w$. The number displayed for "Europe Total" indicates the total per capita absolute shadow cost $C_t$. Panel (B) shows the wellbeing loss of inequality. All estimates are based on a spline specification as shown in equation (4) on page 5. Data: EU-SILC.

### *4.2.3 Inequality estimates*

Dalton (1920) and Atkinson (1970) argued that an appropriate inequality index should reflect the shortfall in welfare due inequality. This argument has received widespread, though not universal, agreement (Dagum 1990; Cowell 2009; McGregor, Smith, and Wills 2019). The inequality index $\tilde{I}$,

**Table 3. Indices of inequality in disposable household incomes across countries**

| | Country | Gini | A(1) | $\tilde{I}$ |
|---|---|---|---|---|
| 1 | Slovakia | 0.288 | 0.141 | 0.148 |
| 2 | Czech Republic | 0.320 | 0.161 | 0.176 |
| 3 | Belgium | 0.325 | 0.172 | 0.216 |
| 4 | Austria | 0.326 | 0.188 | 0.237 |
| 5 | Luxembourg | 0.327 | 0.183 | 0.257 |
| 6 | Norway | 0.329 | 0.186 | 0.224 |
| 7 | Malta | 0.331 | 0.178 | 0.208 |
| 8 | France | 0.331 | 0.173 | 0.218 |
| 9 | Hungary | 0.331 | 0.179 | 0.166 |
| 10 | Switzerland | 0.332 | 0.178 | 0.265 |
| 11 | Iceland | 0.333 | 0.175 | 0.216 |
| 12 | Poland | 0.338 | 0.188 | 0.196 |
| 13 | Slovenia | 0.341 | 0.188 | 0.205 |
| 14 | Netherlands | 0.342 | 0.188 | 0.218 |
| 15 | Sweden | 0.343 | 0.194 | 0.211 |
| 16 | Cyprus | 0.350 | 0.191 | 0.244 |
| 17 | Germany | 0.351 | 0.201 | 0.248 |
| 18 | Finland | 0.351 | 0.192 | 0.219 |
| 19 | United Kingdom | 0.351 | 0.199 | 0.231 |
| 20 | Greece | 0.351 | 0.204 | 0.196 |
| 21 | Ireland | 0.352 | 0.205 | 0.249 |
| 22 | Spain | 0.353 | 0.210 | 0.233 |
| 23 | Italy | 0.361 | 0.224 | 0.240 |
| 24 | Denmark | 0.362 | 0.208 | 0.234 |
| 25 | Portugal | 0.363 | 0.211 | 0.216 |
| 26 | Croatia | 0.377 | 0.238 | 0.215 |
| 27 | Serbia | 0.378 | 0.243 | 0.177 |
| 28 | Estonia | 0.388 | 0.245 | 0.242 |
| 29 | Romania | 0.388 | 0.247 | 0.177 |
| 30 | Bulgaria | 0.418 | 0.269 | 0.243 |
| 31 | Latvia | 0.419 | 0.279 | 0.250 |
| 32 | Lithuania | 0.421 | 0.278 | 0.261 |
| | **Europe** | 0.376 | 0.233 | 0.255 |
| *Rank-rank correlation with Gini* | | 1.000 | 0.963 | 0.333 |

**Note:** Rank-rank correlation is based on Spearman's $\rho$. $\tilde{I}$ is defined in section 2. Data EU-SILC.

defined by equation (9), does this. As a key advantage of this index, there are no free parameters – corresponding to a particular parameterisation of the social welfare function – for the researcher to arbitrarily select. Instead, the index is entirely determined by the observed income distribution and the estimated income-to-wellbeing relationship. In that spirit, Table 3 lists, for each European country, estimates of the Gini, the Atkinson index (with inequality aversion parameter $\varepsilon = 1$), and estimates of $\tilde{I}$. These estimates of $\tilde{I}$, are based on the pooled splines model (shown in Figure 2).

We see that the Atkinson index, the Gini, and the $\tilde{I}$ index do not yield the same rankings across countries. As assessed via the rank-rank correlation, the Gini and Atkinson indices yield rankings of countries much more similar than that of the $\tilde{I}$ index. For example, Bulgaria, Latvia, and Lithuania, are the most unequal countries according to the Gini and Atkinson index. In contrast, the $\tilde{I}$ index indicates that Italy, Switzerland, and Luxemburg are the most unequal European countries.[15] This is because the $\tilde{I}$ index penalises inequality stemming from very high incomes

[15] It may be worth noting that since the index allows for any kind of monotonic utility function, and is not restricted to isoelastic functions, it is not invariant to the income scale.

much more heavily than the traditional inequality indices (since the income-to-wellbeing relationship is essentially flat for such incomes). Thus, if we believe Dalton's (1920) and Atkinson's (1970) arguments about the fundamental purpose of inequality measurement, we may need to revise our standard beliefs about cross-country differences in inequality.

#### *4.2.4 Counterfactuals that are less extreme than equality*

The analyses of the previous section compared the status-quo against model predictions under perfect equality. However, of course, a perfectly equal income distribution is unlikely to be achievable. I therefore assess the consequences of a set of more modest efforts towards redistribution. To do so, I separate the way in which funds for redistribution may be collected and how they may in turn be given out. For both these aspects, I consider two illustrative approaches.

**Collecting funds:** The first approach is to level the incomes of the top $q\%$ of the income distribution. For concreteness, suppose $q = 10$. In that case, I take the income level at the $100 - q = 90^{th}$ percentile and assign that income level to all individuals above the 90th percentile. For these individuals, this constitutes an income loss. That loss is then available for redistribution (detailed below). Call this approach "*flattening-the-top*". The second approach to collecting incomes for redistribution is to simply levy a $p$-percent *linear tax* on all incomes in the data. Evidently, that approach is less progressive. Both counterfactual 'taxes' are levied on disposable household incomes (which have already been taxed according to each country's tax regime).

**Redistributing funds:** The first approach here seeks to be maximally efficient. I take the first Euro available for redistribution and assign it to the currently poorest observation in the data.[16] I then take the second available Euro and repeat the same process. I repeat this until all of the available funds are exhausted (which are raised via either of the 'taxes' described above). Call this approach "*give-to-the-poor*". The second approach simulates a simple *universal basic income*. Concretely, I take all of the available funds, divide them by the total population size, and give each (population-weighted) observation the same amount from that pool. This approach involves no targeting and is, in that sense, less efficient. Although the idea of a universal basic income is frequently discussed (Van Parijs 1991; Hoynes and Rothstein 2019) its potential welfare effects have not been assessed in the style attempted here. Compared to the maximally efficient approach, this approach is of course much less progressive.

**Simulating wellbeing gains:** Figure 5 visualises the results from simulating various counterfactuals along the lines detailed above. Panel (A) shows counterfactuals from collecting funds via the *flattening-the-top* approach. Panel (B) shows the consequences of a *linear tax*. The black lines show what happens when redistributing with an untargeted *universal basic income*. The blue lines indicate the consequences of the targeted *give-to-the-poor* approach.

The solid lines indicate the wellbeing gains predicted for a given amount of redistribution. For both ways of collecting funds, the *give-to-the-poor* approach yields much more rapid wellbeing gains than the *universal basic income* approach. Given that the former is much more progressive than the

[16] Because there about 745,000 observations in my data, I first flatten the data to 4,000 observations. This significantly eases the computational burden while inducing a small approximation error.

latter, this is to be expected. It reflects the idea in social policy that targeted benefits are more efficient than universal benefits (Barr 2020), though they may often be met with less political support (Korpi and Palme 1998). In the case of the *flattening-the-top* combined with the *give-to-the-poor* approach, there are no further gains to be had after flattening the top 34%.[17] More generally, each of the solid lines in Figure 5 are concave. Hence, the rate at which redistribution improves wellbeing declines with the total amount of redistribution.

This latter point is also illustrated by the diamond-shaped markers in the figure. These indicate the level of redistribution required to obtain 50% of all the possible wellbeing gains from redistribution. From the blue diamond in Panel (A) we see that merely redistributing incomes from the top 5% of the income distribution would already be enough to reach such a goal. Likewise, the blue diamond in Panel (B) indicates that a linear tax of about 7% could achieve the same goal.

But how much of a reduction in inequality is realistic? In the data, Slovakia, with a Gini coefficient of 0.288, is the least unequal country in Europe (this is also in line with World Bank (2020) estimates). It seems plausible to believe that the rest of Europe could in principle also achieve this level of inequality. In that spirit, the blue and black circles show the predicted gains if Europe as a whole were to achieve this low level of inequality. Such an effort could yield more than half the total theoretically feasible welfare gain. On top, the required amount of redistribution to achieve this goal is also fairly modest: It could e.g. be achieved with a Europe-wide linear tax of about 8% or by levelling the top ~5% of the income distribution.

**Simulating minimum efficiency:** The analysis above assumed that redistribution would not induce any inefficiencies. Yet, standard economic theory often predicts that taxation and redistribution will lower mean incomes (Mirrlees 1971; Okun 1975; Saez, Slemrod, and Giertz 2012).[18] Such reductions in mean incomes might then lower mean wellbeing – despite a more equal distribution.

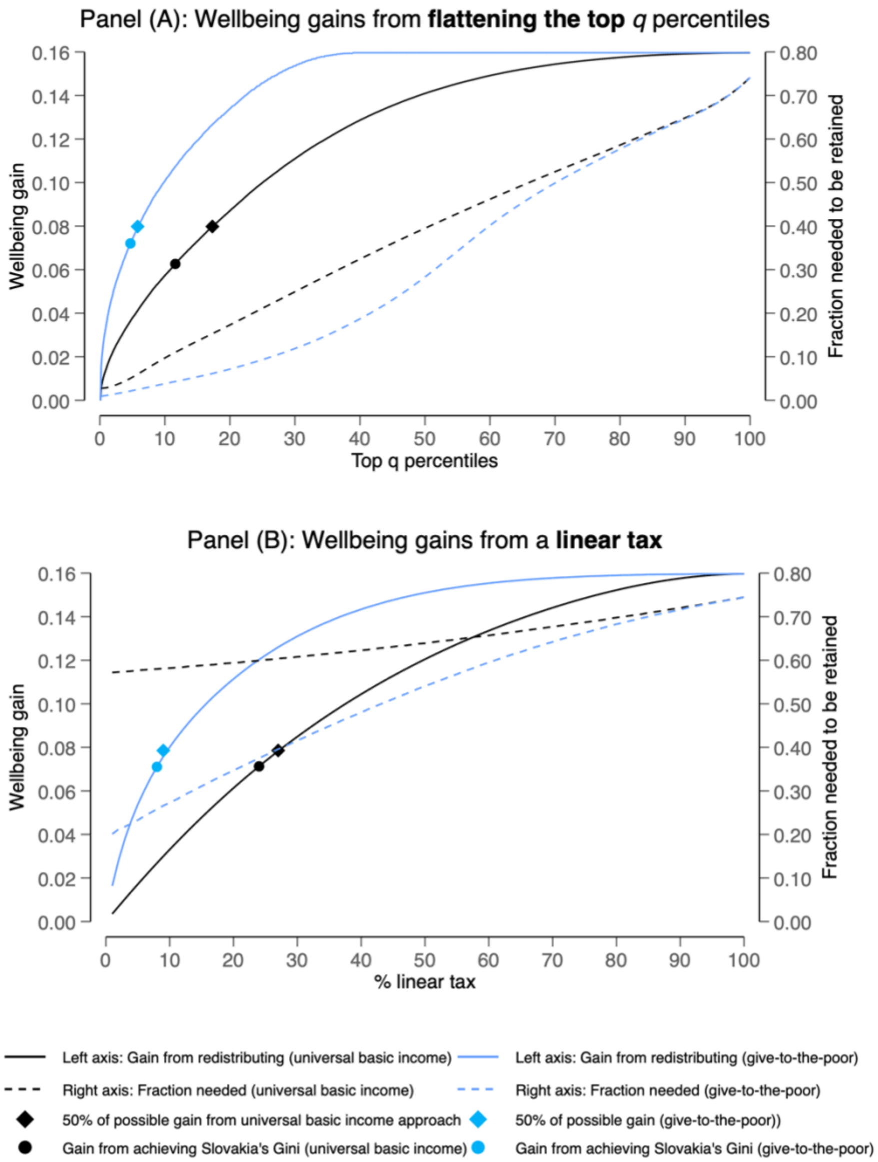
The dashed lines respond to this kind of argument. They show the minimum percentage of collected funds that need to actually be paid out to recipients in order to maintain the same average level of wellbeing as under the status-quo. In that sense, the dashed lines indicate how efficient a given level of redistribution needs to be in order to yield a welfare-gain. A comparison of Panels (A) and (B) shows that the strategy of *flattening-the-top* can be allowed to be much more inefficient than a *linear tax*. This is intuitive: We saw from Figures 2 and 3 that people do not benefit from top incomes. Exclusively taking from the top percentiles consequently causes very little loss in wellbeing in comparison to an approach that collects at least some funds from all individuals.

The combination of a *linear tax* with a *universal basic income* requires the most efficiency. For example, in the case of a 10% linear tax, about 60% of the collected revenues must arrive to recipients to yield a net welfare gain. In contrast, the *give-to-the-poor* approach merely requires that approximately 30% of the collected revenues arrive.

[17] This is mechanical: the 62nd percentile is where the mean of the income distribution is located. Therefore, flattening the top 38% and redistributing to the poorest 62% will yield a perfectly equal income distribution.

[18] The extent to which this holds empirically continues to be hotly debated (Banerjee and Duflo 2003; Halter, Oechslin, and Zweimüller 2014; Stiglitz 2015). But most would agree that enforcing perfect equality lowers mean incomes.

**Figure 5. Consequences of partial redistribution**




**Note:** Panel (A) shows the results from collecting funds by *flattening-the-top* $q$ percentiles. Panel (B) shows the results based on a *linear tax*. The black lines indicates the model prediction when redistributing using a *universal basic income*, i.e. giving all individuals the same share of funds raised. The blue lines indicate predictions for the targeted *give-to-the-poor* approach. All results depend on a pooled splines model, corresponding to the solid line in Figure 2. Data: EU-SILC.

Finally, each of the dashed lines converge to a figure of about 74% on the far-right. At that point, each approach – whether we use a 100% tax or equalise the top 100 percentiles – would result in a perfectly equal income distribution. The figure of 74% is equivalent to a value of $\tilde{c} = 0.74$ (c.f. the end of section 2).

### 4.3 Robustness tests

**Using data on happiness and depression:** Thus far, I assumed that respondent's life satisfaction is an adequate proxy for overall wellbeing. There can be reasonable disagreement over this position. This is a fundamentally normative question. While life satisfaction has been defended by both philosophers and economists (Sumner 1996; Tiberius 2015; Clark et al. 2019), others have favoured more affective conceptions of wellbeing, such as happiness or affect (Ng 1997; Plant 2020).

The EU-SILC survey asked respondents *"How much of the time over the past four weeks have you been happy?"* and *"How much of the time over the past four weeks have you felt down-hearted or depressed?"*. These questions were answered on a scale from 1 ("*None of the time*") to 5 ("*All of the time*"). To assess how the results differ under these alternative conceptions of wellbeing, I use responses to these questions and estimate models equivalent to those shown in Figure 2. Results are shown in Table 4 and Figure 6 (n.b. the data for 'feeling depressed' are reverse coded).

In line with Kahneman and Deaton (2010) using happiness data leads to a much earlier point of satiation. Respondents do not appear to become happier for incomes above €45k. As a consequence, the welfare loss due to inequality is much greater when using happiness data. With $c = 1.932$, the welfare loss from inequality is roughly equivalent to a full income doubling for every European citizen. Likewise, when using data on feeling depressed, the welfare cost of inequality is again larger than was true when using satisfaction (albeit to a less pronounced extent).

**Relaxing cardinality:** Following Ferrer-i-Carbonell and Frijters (2004), the analysis so far assumed that self-reported data can be interpreted cardinally. That is, I assumed that the difference in underlying wellbeing between choosing (say) a 3/10 and a 4/10 is the same as the difference between a (say) 7/10 and an 8/10. Kaiser and Oswald (2022) previously argued that estimates of the curvature of the income-to-wellbeing relationship crucially depend on this assumption.[19] To assess the force of this argument, I perform three robustness analyses: First, I use a strongly convex transformation of reported wellbeing. Specifically, I define $\widetilde{w}_i = 1.5^{w_i}$, where $w_i$ is the standard self-reported data on wellbeing. The new variable $\widetilde{w}_i$ implicitly assumes that differences in underlying wellbeing increase by a factor of $50\%$ between adjacent response options. Using, $\widetilde{w}_i$ I then recalculate the cost of inequality. Second, I use a strongly concave transformation of the form $\widetilde{\widetilde{w}}_i = -0.66^{w_i}$. This assumes that differences in underlying wellbeing decline by a factor of $50\%$ between adjacent response options. Kaiser and Vendrik (2022) presented evidence to suggest that it would be unlikely for respondents to answer survey questions in a way that is more non-linear than these transformations.

[19] This can be seen as follows. To find the 'curvature' of the income-to-wellbeing relationship, we are ultimately interested in the second derivative of the function $w_i = f(y_i)$ (c.f. section 2). Yet, we only observe $g(w_i) = r_i$, where $r_i$ represents the chosen integer coded response category. One could thus object that the estimates shown thus far only give the estimates of the composition $h = g(f(y_i))$. Taking derivatives of $h$ with respect to $y_i$ we get $h' = f'(g(w))g'(w)$ and $h'' = f''(g(w))g'(w) + f'(g(w))g''(w)$. The estimates may therefore either be driven by the curvature of the reporting function $g''(w)$ or the curvature of the actual utility function $f''(g(w))$. See Oswald (2008) for this argument, and Schröder and Yitzhaki (2017) and Bond and Lang (2019) for similar such arguments concerning the wellbeing literature in general.

**Table 4. Alternative estimates of the welfare cost of inequality**

| | Pecuniary shadow cost | Wellbeing loss | Wellbeing loss from Unemployment/Divorce | |
|---|---|---|---|---|
| | (1) $c$ ($C$) | (2) $\Delta W_t$ | (3) $\Delta W_{unemp.}$ | (4) $\Delta W_{divor.}$ |
| 1 Baseline pooled splines | 1.434 (€13,892) | 0.160 | 0.030 | 0.037 |
| 2 Happiness data | 1.932 (€29,834) | 0.059 | 0.009 | 0.014 |
| 3 Depression data | 1.481 (€15,397) | 0.047 | 0.009 | 0.008 |
| 4 Convex transformation | 1.295 (€9,443) | 0.145 | 0.028 | 0.041 |
| 5 Concave transformation | 1.750 (€24,008) | 0.098 | 0.018 | 0.020 |
| 6 Ordered probit model | 1.361 (€11,556) | 0.081 | 0.015 | 0.020 |
| 7 Top-income adjustment | 1.511 (€16,357) | 0.160 | 0.034 | 0.037 |
| 8 Reference effects | 1.821 (€26,281) | 0.203 | 0.030 | 0.036 |
| 9 German panel data (fixed effects) | 1.342 (€12,428) | 0.063 | 0.016 | 0.010 |
| 10 German panel data (pooled) | 1.244 (€8,867) | 0.097 | 0.075 | 0.030 |
| 11 EU-SILC data on Germany | 1.369 (€14,365) | 0.177 | 0.053 | 0.036 |

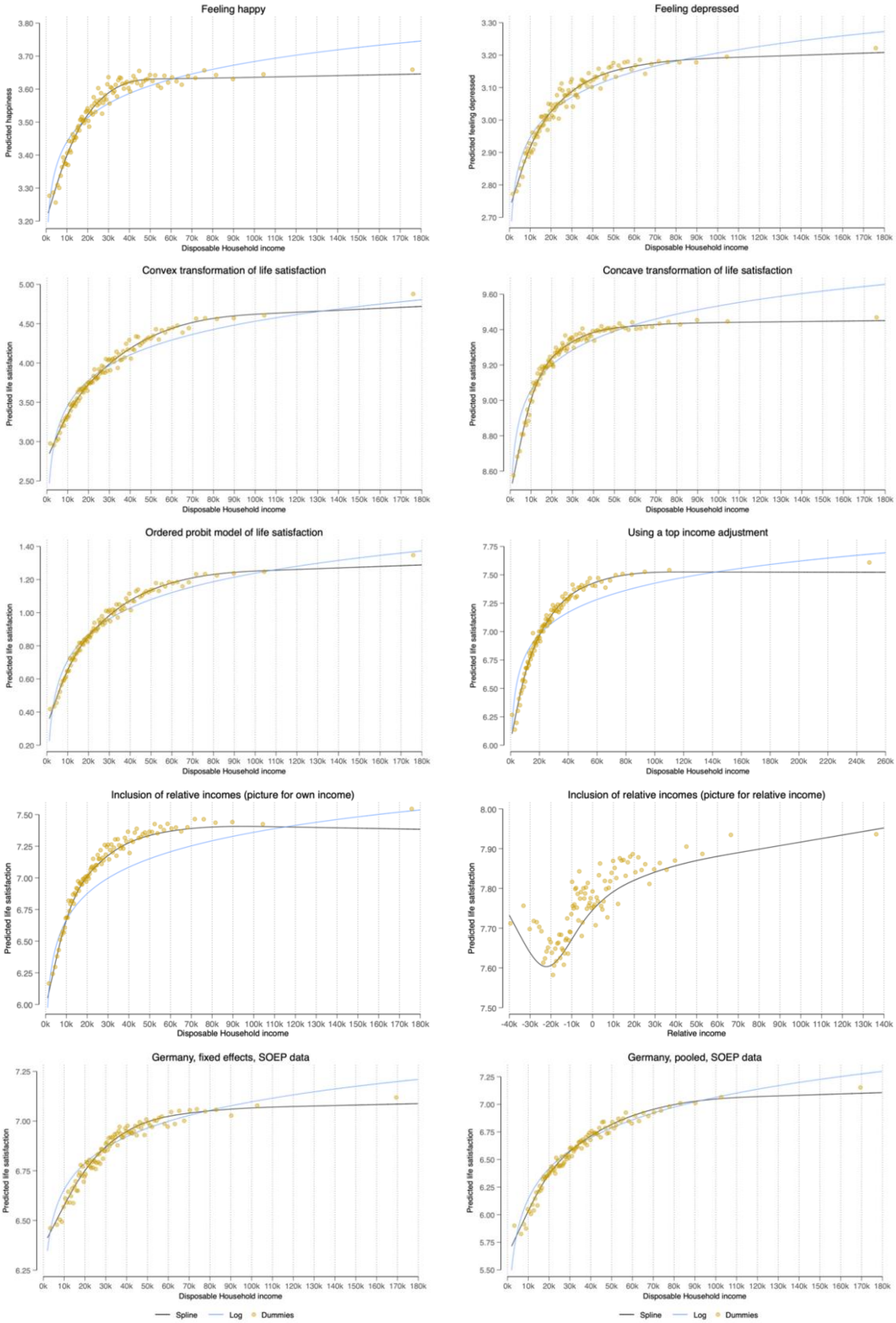
**Note:** Data: EU-SILC and German Socio-Economic Panel. Columns (3) and (4) show wellbeing losses due to unemployment and divorce. For all specifications we see that the wellbeing loss due to inequality is much larger than these.

The convex transformation reweights the top response categories to be more important than the bottom response categories. Given that richer individuals are more likely to be using the top response options, this reduces the curvature of the estimate income-to-wellbeing relationship. This is clearly visible in Figure 6. Consequently, the cost of inequality is somewhat reduced from $c = 1.434$ to $c = 1.295$. Inversely, the concave transformations weights the bottom categories more strongly than the top categories. Thus, the curvature of the income-to-wellbeing relationship is more pronounced, and the welfare cost of inequality rises substantially to $c = 1.750$. Finally, following Chen et al. (2022), I also estimated an ordered probit model. In that case, results indicate a slightly smaller shadow cost of inequality.

**Top income adjustment:** Carranza, Morgan, and Nolan (2022) showed that the standard EU-SILC surveys understate the true extent of income inequality in Europe. They propose to adjust the income data such that they match known income shares from administrative tax data, as available in the World Inequality Database. To assess the extent to which this underestimation matters, I re-estimate my original models using the adjusted income figures from Carranza et al. (2022). As expected, when using the adjusted income figures, the welfare cost of inequality increases moderately.

**Inclusion of reference effects:** As noted from the outset, the analysis focuses on the curvature of the effect of people's own absolute income. Nevertheless, the previous literature has often invoked social reference effects as a core reason for why cross-country studies do find that inequality is associated with lower mean wellbeing. It thus seems appropriate to give an initial assessment of this potential channel within the framework of the present paper. For that purpose, I constructed a measure of relative income and recalculated the welfare cost of wellbeing. The definition of relative incomes follows a series of previous works that have defined the relevant reference groups on an *a priori* basis (McBride 2001; Ferrer-i-Carbonell 2005; Vendrik 2013; Kaiser 2020). Specifically, I define reference incomes $y_i^{ref}$ to be the mean income of individuals observed in the same year, 10-year age range and the same education level (distinguishing between no education, primary education, secondary education, and tertiary education). Relative incomes are

**Figure 6. Alternative specifications to estimate the income-to-wellbeing relationship.**




**Note:** Each panel corresponds to one of the robustness estimations shown in Table 4. The estimated income-to-wellbeing relationship is concave in all cases, implying a welfare loss from inequality. Data: EU-SILC & German Socio-Economic Panel.

splines for $y_i^{rel}$ are then added to the regression equation. We should expect that, just like absolute incomes, relative income effects will only increase the welfare cost of inequality if the relative-income-to-wellbeing relationship is concave. However, in Figure 6, this relationship is positive (as one would expect), but not concave. Yet, including relative incomes in the regression models causes the absolute-income-to-wellbeing relationship to become more concave. In turn, the estimated welfare cost of inequality increases. This is especially true in terms of the shadow cost of inequality, which is now estimated to equal $c = 1.821$, i.e. about 82% of disposable HH incomes. This is a notable increase. Hence, future work should continue to advance a better understanding of reference effects, especially concerning whom people compare to (see Mayraz, Wagner, and Schupp 2009; Clark and Senik 2010; Dufhues et al. 2022 for work in this direction).

**Using panel data:** The EU-SILC data, in virtue of only including cross-sectional information on wellbeing, does not allow the use of a fixed effects model. It is known that fixed effects, which control for time-constant heterogeneities across respondents, tend to reduce the magnitudes of estimated coefficients. We may hence believe that the welfare cost of inequality is overestimated. To assess this, I re–estimated my analyses with longitudinal data from the German Socio-Economic Panel ('SOEP'). Covering the period between 1984-2018, I have about 585,000 observations available. The same income concept and controls[20] are used. I compare these results to pooled analyses for Germany based on both SOEP and based on EU-SILC data. As expected, the absolute wellbeing loss $\Delta W$ is reduced by a third when including fixed effects. However, the shadow cost of inequality only depends on the curvature of the income-to-wellbeing relationship, but not its absolute magnitude. The inclusion of individual fixed-effects *increases* this curvature. Hence, the shadow cost of inequality is estimated to be slightly larger for German SOEP data when using fixed effects compared to a pooled analysis. Moreover, the figure computed with the SOEP fixed effects analysis is remarkably close to the figure obtained using the cross-sectional EU-SILC data for Germany. I therefore conclude that while the omission of fixed effects is likely to overstate the absolute wellbeing loss of $\Delta W$, it does not seem to substantially affect estimates of the shadow cost of inequality.

**Summary of robustness tests:** Collectively, these robustness tests indicate that the estimated welfare cost of inequality is somewhat affected by both empirical (e.g. concerning cardinality) and normative (e.g. happiness or life satisfaction?) assumptions. We can nevertheless infer some reasonable bounds on the extent to which income inequality creates a welfare loss.

No matter the specification, I always find a concave income-to-wellbeing relationship. This is even true when considering an extreme convex transformation of the reported satisfaction data. Hence, it seems clear that inequality does indeed harm wellbeing. An absolute (relative) shadow cost of inequality of €9,443 (29.5%). is the smallest estimate obtained for Europe as a whole. We may view this as a lower bound.

Finally, the specification that included relative incomes suggested that the welfare cost of inequality is larger when accounting for peoples' reactions to the incomes of peers. Likewise, the estimates using happiness data, the estimates that account for the underestimation of top-income shares in

[20] Except for omitting an urban/rural dummy and replacing country fixed effects with an East vs. West fixed effect.

EU-SILC, and the estimates that account for a possibly concave reporting function, all points towards a higher shadow cost of inequality, too. In contrast, my panel estimations do not suggest a qualitatively smaller such cost.

## 5 Conclusion

Building on the earlier theoretical literature on inequality measurement and its connection with the curvature of individual utility functions (and social welfare functions more generally; Dalton 1920; Dagum 1990; Cowell 2009), I suggested to add empirical content to the long-established approach of studying the welfare cost of inequality pioneered by Atkinson (1970).

That approach proceeded in two simple steps. In the first, I estimated the individual-level curvature of the income-to-wellbeing relationship for a large number of European countries. Doing so is now feasible with the increased availability of survey data on individual's wellbeing. In the second step, I then used the estimated relationship to counterfactually estimate (1) how much poorer individuals could be under a state of perfect equality (to obtain the *shadow cost of inequality*) and (2) how much larger average wellbeing under equality might be (to obtain the absolute *wellbeing loss* of inequality). Regarding the former, my baselines estimates yield a relative shadow cost of inequality of about 43% of disposable household incomes. In absolute terms, this is equivalent to about €13,000-€14,000. Regarding the latter, my baseline estimates yield a wellbeing loss of 0.16 points on a 0-10 life satisfaction scale. While seemingly small in absolute terms, this is roughly five times the size of the gain in wellbeing that could be expected from completely eradicating unemployment in Europe.

A particularly useful aspect of the *shadow cost of inequality* is that it tells us how great of a monetary loss may be incurred from redistribution while still increasing welfare. Building on that thought, and since perfect equality is unlikely to be an attainable goal, I estimated a series of alternative counterfactuals. These counterfactuals show that an additional flat tax of about 7% would be enough to yield 50% of the welfare gain predicted to occur under perfect equality. Reaching such levels of inequality is eminently feasible: attaining the level of inequality in Slovakia – Europe's least unequal country – would require a more demanding effort. Likewise, a tax of this sort, coupled with a targeted approach towards redistributing funds, could be allowed to be surprisingly inefficient: I estimate that even if only 30% of funds are successfully paid out, a net welfare gain would still obtain. Thus, tackling income inequality is very likely to improve the lives of Europeans, even when that comes at a net pecuniary loss.

Several limitations remain: First, I did not provide a model of behavioural responses to any redistributive efforts. I simply estimated how large the behavioural response against a redistributive effort may maximally be. A next step would usefully provide a joint model of behavioural responses and wellbeing effects, which in turn could provide novel recommendations for designing both optimal tax- and social-policy (c.f. Barr 2020).

Second, heterogeneities across population groups, e.g. age or gender have not been considered (see Boyce and Wood (2011) or Murtin et al. (2017) for work in that direction). If, for example, individuals at older ages benefit more from higher incomes than those at younger ages, then an equal distribution of incomes would not be optimal in the sense of maximising mean wellbeing. Policy should potentially be sensitive to such heterogeneities.

Third, I did not model loss-aversion. We know that, in the short-term, losses loom larger than gains (Boyce et al. 2013; De Neve et al. 2018). Hence, we may expect that the wellbeing losses of richer individuals will be larger than what is suggested by the static models here estimated.

Fourth, my estimates of the income-to-wellbeing relationship relied on purely observational data. The extent to which this particular curvature is causal remains unclear. In order to study this cleanly, we would need to observe lasting exogenous variation in incomes across the *entire* income distribution. It is, unfortunately, unlikely that such variation will become available at the scale required. That said, my panel-estimations, which control for time-invariant heterogeneities, yield roughly the same curvature. In addition, smaller-scale studies based on lottery wins (Lindqvist, Östling, and Cesarini 2020) or one-off cash transfers (Dwyer and Dunn 2022) are also consistent with the amount of curvature in the income-to-wellbeing relationship observed here.

It will be possible to eventually overcome most of these limitations. Doing so would further improve on the estimates provided here. Until then, it seems that the loss from income inequality is larger than about 40% of European's disposable household incomes. This is a large social ill. We can do more to tackle it.

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# Appendix

## Additional Tables

**Table A1. Descriptive Statistics.**

| Variable | N | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| Life Satisfaction | 746,093 | 7.14 | 2.00 | 0.00 | 10.00 |
| Happiness | 732,076 | 3.59 | 0.91 | 1.00 | 5.00 |
| Feeling Depressed | 735,027 | 2.99 | 0.99 | 0.00 | 4.00 |
| Disposable Household Income | 746,093 | 32,010 | 29,029 | 0.21 | 4,030,000 |
| Unemployment | 746,093 | 0.06 | 0.24 | 0.00 | 1.00 |
| Divorce | 746,093 | 0.02 | 0.12 | 0.00 | 1.00 |

**Note:** Mean and standard deviations are all reported after applying sampling- and population-weights. Data: 2013 and 2018 EU-SILC, covering 32 countries.

**Table A2. Full regression table of pooled specifications shown in Table 1**

| | (1)<br>Log | (2)<br>Isoelastic | (3)<br>Splines | (4)<br>Dummies |
|---|---|---|---|---|
| Ln(Disposable HH income) | 0.409*** | | | |
| | (0.035) | | | |
| Coefficient on disposable HH incomes | | 0.135*** | | |
| | | (0.022) | | |
| Curvature of the disposable HH income effect (rho) | | 0.884*** | | |
| | | (0.016) | | |
| 1st Disposable HH income spline | | | 0.000*** | |
| | | | (0.000) | |
| 2nd Disposable HH income spline | | | -0.002*** | |
| | | | (0.000) | |
| 3rd Disposable HH income spline | | | 0.002*** | |
| | | | (0.000) | |
| 4th Disposable HH income spline | | | -0.000*** | |
| | | | (0.000) | |
| Age | -0.176*** | -0.174*** | -0.177*** | -0.177*** |
| | (0.012) | (0.007) | (0.007) | (0.012) |
| Age-squared | 0.003*** | 0.003*** | 0.003*** | 0.003*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Age-cubed | -0.000*** | -0.000*** | -0.000*** | -0.000*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Primary education | 0.177+ | 0.178*** | 0.172*** | 0.171+ |
| | (0.101) | (0.035) | (0.035) | (0.100) |
| Lower secondary education | 0.372* | 0.374*** | 0.361*** | 0.360* |
| | (0.166) | (0.036) | (0.035) | (0.166) |
| Upper secondary education | 0.516** | 0.516*** | 0.496*** | 0.494** |
| | (0.156) | (0.035) | (0.035) | (0.155) |
| Post-secondary non-tertiary education | 0.669*** | 0.659*** | 0.639*** | 0.637*** |
| | (0.153) | (0.036) | (0.036) | (0.150) |
| Tertiary education | 0.212 | 0.211*** | 0.201*** | 0.200 |
| | (0.185) | (0.054) | (0.054) | (0.182) |
| Suburban | 0.055** | 0.057*** | 0.057*** | 0.057** |
| | (0.016) | (0.009) | (0.009) | (0.016) |
| Rural | 0.069* | 0.072*** | 0.075*** | 0.075** |
| | (0.027) | (0.009) | (0.009) | (0.027) |
| Urbanisation: missing | -0.242*** | -0.243*** | -0.239*** | -0.239*** |
| | (0.034) | (0.022) | (0.022) | (0.035) |
| Limited due to health problems | 0.978*** | 0.977*** | 0.974*** | 0.975*** |
| | (0.076) | (0.018) | (0.018) | (0.074) |
| Not limited due to health problems | 1.638*** | 1.635*** | 1.630*** | 1.629*** |
| | (0.122) | (0.017) | (0.017) | (0.120) |
| Health information missing | 0.975*** | 0.974*** | 0.968*** | 0.970*** |
| | (0.174) | (0.057) | (0.057) | (0.175) |
| 2 Adults in HH | -0.059 | -0.066*** | -0.112*** | -0.114* |
| | (0.043) | (0.013) | (0.013) | (0.042) |
| 3 Adults in HH | -0.259*** | -0.272*** | -0.327*** | -0.329*** |
| | (0.046) | (0.015) | (0.015) | (0.044) |
| 4 Adults in HH | -0.333*** | -0.352*** | -0.408*** | -0.410*** |
| | (0.053) | (0.017) | (0.017) | (0.054) |
| 5 Adults in HH | -0.412*** | -0.434*** | -0.495*** | -0.496*** |
| | (0.054) | (0.025) | (0.026) | (0.055) |
| 6 Adults in HH | -0.461*** | -0.485*** | -0.555*** | -0.556*** |
| | (0.049) | (0.040) | (0.040) | (0.050) |
| 7 Adults in HH | -0.795** | -0.824*** | -0.894*** | -0.897*** |
| | (0.233) | (0.101) | (0.101) | (0.230) |
| 8 Adults in HH | -1.113*** | -1.132*** | -1.224*** | -1.229*** |
| | (0.125) | (0.110) | (0.109) | (0.125) |
| 9 Adults in HH | -0.321 | -0.349 | -0.399+ | -0.384 |

| | | | | |
|---|---|---|---|---|
| | (0.498) | (0.212) | (0.215) | (0.525) |
| 10 Adults in HH | 0.743** | 0.722*** | 0.648*** | 0.658** |
| | (0.265) | (0.165) | (0.160) | (0.224) |
| 11 Adults in HH | -1.141* | -1.168** | -1.318*** | -1.354** |
| | (0.438) | (0.361) | (0.358) | (0.444) |
| 12 Adults in HH | -1.978*** | -2.001** | -2.164** | -2.176*** |
| | (0.457) | (0.662) | (0.658) | (0.432) |
| 13 Adults in HH | -3.529*** | -3.529*** | -3.595*** | -3.603*** |
| | (0.094) | (0.274) | (0.272) | (0.111) |
| 14+ Adults in HH | -0.857*** | -0.897** | -1.020*** | -1.003*** |
| | (0.157) | (0.282) | (0.280) | (0.137) |
| 1 Child in HH | 0.006 | 0.007 | 0.003 | 0.003 |
| | (0.016) | (0.015) | (0.015) | (0.016) |
| 2 Children in HH | -0.007 | -0.009 | -0.015 | -0.015 |
| | (0.036) | (0.017) | (0.017) | (0.036) |
| 3 Children in HH | 0.036 | 0.032 | 0.028 | 0.027 |
| | (0.057) | (0.036) | (0.036) | (0.054) |
| 4 Children in HH | -0.062 | -0.068 | -0.074 | -0.073 |
| | (0.123) | (0.079) | (0.079) | (0.123) |
| 5 Children in HH | -0.151 | -0.166 | -0.120 | -0.121 |
| | (0.192) | (0.187) | (0.189) | (0.185) |
| 6 Children in HH | 0.467 | 0.470+ | 0.457+ | 0.464 |
| | (0.285) | (0.277) | (0.276) | (0.288) |
| 7 Children in HH | -0.287+ | -0.303 | -0.293 | -0.269+ |
| | (0.151) | (0.263) | (0.258) | (0.156) |
| 8 Children in HH | -1.158 | -1.189 | -1.198 | -1.189 |
| | (1.269) | (0.797) | (0.786) | (1.268) |
| 9 Children in HH | -0.635 | -0.606 | -0.619 | -0.602 |
| | (0.459) | (0.879) | (0.883) | (0.479) |
| 10 Children in HH | -3.395*** | -3.373*** | -3.412*** | -3.427*** |
| | (0.163) | (0.210) | (0.210) | (0.151) |
| 11+ Children in HH | -1.606** | -1.583** | -1.546** | -1.510** |
| | (0.497) | (0.566) | (0.569) | (0.549) |
| Self-employed | 0.037 | 0.032* | 0.055*** | 0.054* |
| | (0.025) | (0.014) | (0.014) | (0.024) |
| Other employed | -0.058 | -0.060 | -0.048 | -0.047 |
| | (0.144) | (0.109) | (0.109) | (0.140) |
| Unemployed | -0.507*** | -0.509*** | -0.477*** | -0.477*** |
| | (0.073) | (0.023) | (0.023) | (0.069) |
| Retired | 0.326*** | 0.329*** | 0.326*** | 0.327*** |
| | (0.054) | (0.021) | (0.021) | (0.054) |
| Inactive | 0.136+ | 0.135*** | 0.150*** | 0.150* |
| | (0.070) | (0.020) | (0.020) | (0.069) |
| Other inactive | -0.102 | -0.098 | -0.082 | -0.082 |
| | (0.084) | (0.085) | (0.085) | (0.082) |
| Employment status missing | -0.196*** | -0.195*** | -0.181*** | -0.182*** |
| | (0.041) | (0.043) | (0.043) | (0.041) |
| European Migrant | -0.022 | -0.023 | -0.015 | -0.016 |
| | (0.022) | (0.022) | (0.022) | (0.022) |
| Non-European Migrant | -0.119 | -0.117*** | -0.110*** | -0.110 |
| | (0.070) | (0.016) | (0.016) | (0.070) |
| Migrant Status missing | -0.186 | -0.186 | -0.187 | -0.182 |
| | (0.186) | (0.125) | (0.125) | (0.187) |
| Female | 0.086*** | 0.086*** | 0.086*** | 0.086*** |
| | (0.019) | (0.008) | (0.008) | (0.019) |
| Home owner (with mortgage) | -0.064 | -0.067*** | -0.071*** | -0.070 |
| | (0.047) | (0.010) | (0.010) | (0.047) |
| Renting | -0.265*** | -0.257*** | -0.257*** | -0.257*** |
| | (0.046) | (0.012) | (0.012) | (0.049) |
| Social renting | -0.294** | -0.285*** | -0.282*** | -0.282** |
| | (0.083) | (0.020) | (0.020) | (0.083) |

| | | | | |
|---|---|---|---|---|
| Accommodation provided for free | -0.089* | -0.088*** | -0.078*** | -0.078* |
| | (0.036) | (0.018) | (0.018) | (0.036) |
| Housing status missing | -0.117 | -0.124 | -0.093 | -0.090 |
| | (0.128) | (0.207) | (0.206) | (0.114) |
| Married | 0.379*** | 0.376*** | 0.379*** | 0.379*** |
| | (0.041) | (0.011) | (0.011) | (0.041) |
| Separated | -0.208*** | -0.210*** | -0.209*** | -0.209*** |
| | (0.039) | (0.033) | (0.033) | (0.038) |
| Widowed | -0.027 | -0.033+ | -0.027 | -0.026 |
| | (0.041) | (0.017) | (0.018) | (0.037) |
| Divorced | -0.082** | -0.082*** | -0.077*** | -0.076** |
| | (0.025) | (0.017) | (0.017) | (0.026) |
| Marital Status Missing | 0.072 | 0.001 | -0.059 | -0.109 |
| | (0.383) | (0.305) | (0.285) | (0.334) |
| Industry=Mining, Manufacturing, Energy | 0.032 | 0.032 | 0.024 | 0.026 |
| | (0.043) | (0.024) | (0.024) | (0.040) |
| Industry=Construction | 0.041 | 0.043 | 0.036 | 0.038 |
| | (0.025) | (0.028) | (0.028) | (0.023) |
| Industry=Wholesale | 0.024 | 0.026 | 0.020 | 0.021 |
| | (0.038) | (0.024) | (0.024) | (0.034) |
| Industry=Transportation | 0.023 | 0.025 | 0.012 | 0.014 |
| | (0.031) | (0.030) | (0.030) | (0.027) |
| Industry=Accommodation and food services | -0.014 | -0.010 | -0.013 | -0.011 |
| | (0.043) | (0.034) | (0.034) | (0.039) |
| Industry=Information & communication | 0.070 | 0.063* | 0.059+ | 0.060 |
| | (0.047) | (0.031) | (0.031) | (0.043) |
| Industry=Finance & insurance | 0.051 | 0.041 | 0.042 | 0.044 |
| | (0.049) | (0.031) | (0.031) | (0.046) |
| Industry=Real estate & science | -0.022 | -0.025 | -0.025 | -0.023 |
| | (0.042) | (0.025) | (0.025) | (0.038) |
| Industry=Missing | -0.283*** | -0.286*** | -0.284*** | -0.283*** |
| | (0.024) | (0.028) | (0.028) | (0.024) |
| Industry=Public administration | 0.129** | 0.127*** | 0.113*** | 0.115** |
| | (0.038) | (0.026) | (0.026) | (0.037) |
| Industry=Education | 0.111** | 0.111*** | 0.102*** | 0.104** |
| | (0.037) | (0.026) | (0.026) | (0.035) |
| Industry=Health | 0.020 | 0.019 | 0.014 | 0.016 |
| | (0.026) | (0.025) | (0.025) | (0.024) |
| Industry=Arts & entertainment | 0.102* | 0.104*** | 0.101*** | 0.103** |
| | (0.038) | (0.029) | (0.029) | (0.037) |
| Job hours | 0.002* | 0.002*** | 0.002*** | 0.002* |
| | (0.001) | (0.000) | (0.000) | (0.001) |
| 2nd Pct. of Inc. Dist. | | | | 0.059 |
| | | | | (0.058) |
| 3rd Pct. of Inc. Dist. | | | | 0.105+ |
| | | | | (0.059) |
| 4th Pct. of Inc. Dist. | | | | 0.190* |
| | | | | (0.088) |
| 5th Pct. of Inc. Dist. | | | | 0.243* |
| | | | | (0.098) |
| 6th Pct. of Inc. Dist. | | | | 0.324** |
| | | | | (0.106) |
| 7th Pct. of Inc. Dist. | | | | 0.362** |
| | | | | (0.120) |
| 8th Pct. of Inc. Dist. | | | | 0.395** |
| | | | | (0.128) |
| 9th Pct. of Inc. Dist. | | | | 0.388* |
| | | | | (0.142) |
| 10th Pct. of Inc. Dist. | | | | 0.423** |
| | | | | (0.122) |
| 11th Pct. of Inc. Dist. | | | | 0.496** |
| | | | | (0.155) |

| | |
|---|---|
| 12th Pct. of Inc. Dist. | 0.508*** |
| | (0.130) |
| 13th Pct. of Inc. Dist. | 0.506*** |
| | (0.129) |
| 14th Pct. of Inc. Dist. | 0.644*** |
| | (0.134) |
| 15th Pct. of Inc. Dist. | 0.570*** |
| | (0.118) |
| 16th Pct. of Inc. Dist. | 0.623*** |
| | (0.108) |
| 17th Pct. of Inc. Dist. | 0.647*** |
| | (0.135) |
| 18th Pct. of Inc. Dist. | 0.648*** |
| | (0.135) |
| 19th Pct. of Inc. Dist. | 0.700*** |
| | (0.123) |
| 20th Pct. of Inc. Dist. | 0.636*** |
| | (0.141) |
| 21th Pct. of Inc. Dist. | 0.719*** |
| | (0.118) |
| 22th Pct. of Inc. Dist. | 0.710*** |
| | (0.124) |
| 23th Pct. of Inc. Dist. | 0.768*** |
| | (0.133) |
| 24th Pct. of Inc. Dist. | 0.761*** |
| | (0.140) |
| 25th Pct. of Inc. Dist. | 0.822*** |
| | (0.115) |
| 426th Pct. of Inc. Dist. | 0.746*** |
| | (0.129) |
| 27th Pct. of Inc. Dist. | 0.804*** |
| | (0.134) |
| 28th Pct. of Inc. Dist. | 0.820*** |
| | (0.129) |
| 29th Pct. of Inc. Dist. | 0.814*** |
| | (0.130) |
| 30th Pct. of Inc. Dist. | 0.807*** |
| | (0.126) |
| 31th Pct. of Inc. Dist. | 0.855*** |
| | (0.132) |
| 32th Pct. of Inc. Dist. | 0.855*** |
| | (0.124) |
| 33th Pct. of Inc. Dist. | 0.855*** |
| | (0.129) |
| 34th Pct. of Inc. Dist. | 0.882*** |
| | (0.150) |
| 35th Pct. of Inc. Dist. | 0.841*** |
| | (0.138) |
| 36th Pct. of Inc. Dist. | 0.889*** |
| | (0.125) |
| 37th Pct. of Inc. Dist. | 0.883*** |
| | (0.126) |
| 38th Pct. of Inc. Dist. | 0.870*** |
| | (0.147) |
| 39th Pct. of Inc. Dist. | 0.911*** |
| | (0.130) |
| 40th Pct. of Inc. Dist. | 0.948*** |
| | (0.124) |
| 41th Pct. of Inc. Dist. | 0.964*** |
| | (0.125) |
| 42th Pct. of Inc. Dist. | 0.980*** |
| | (0.136) |

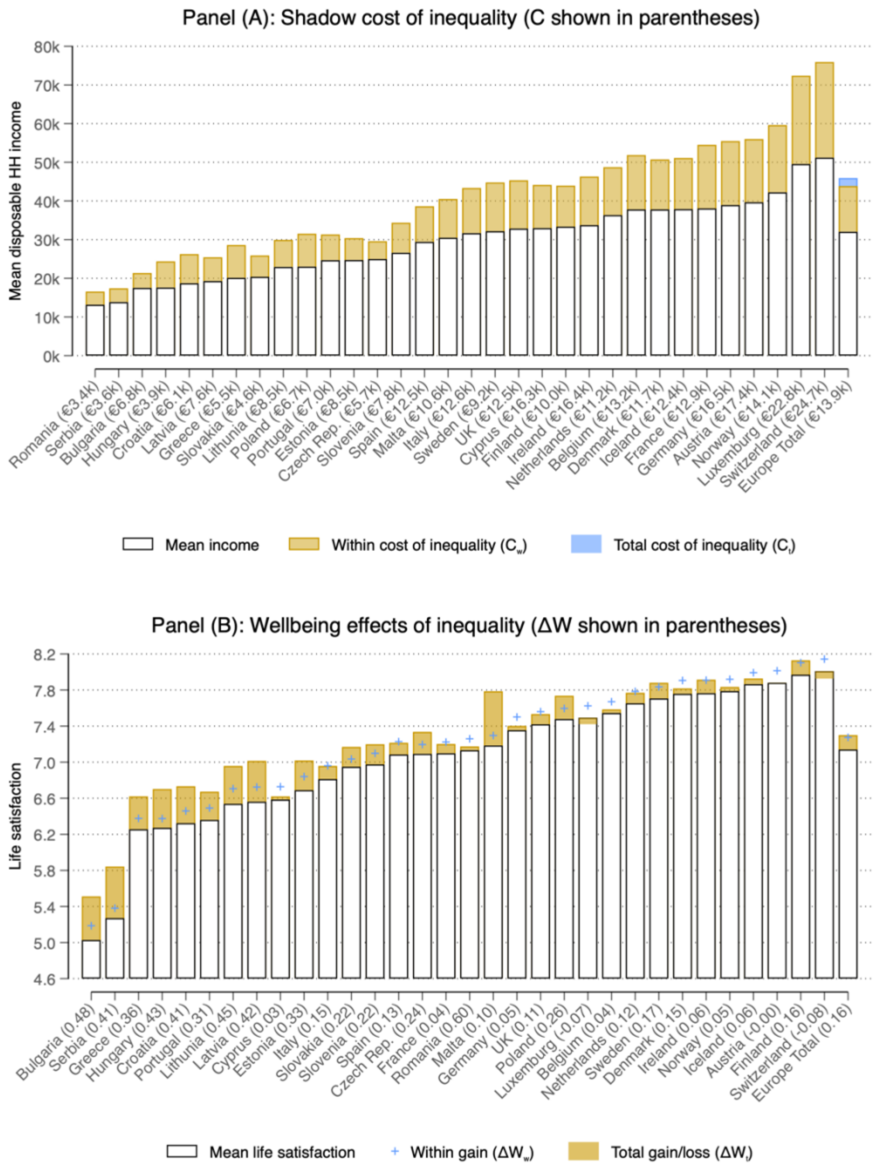
| | |
|---|---|
| 43th Pct. of Inc. Dist. | 1.032*** |
| | (0.136) |
| 44th Pct. of Inc. Dist. | 0.965*** |
| | (0.136) |
| 45th Pct. of Inc. Dist. | 0.957*** |
| | (0.147) |
| 46th Pct. of Inc. Dist. | 0.989*** |
| | (0.133) |
| 47th Pct. of Inc. Dist. | 0.995*** |
| | (0.147) |
| 48th Pct. of Inc. Dist. | 1.078*** |
| | (0.134) |
| 49th Pct. of Inc. Dist. | 1.047*** |
| | (0.130) |
| 50th Pct. of Inc. Dist. | 1.044*** |
| | (0.148) |
| 51th Pct. of Inc. Dist. | 1.119*** |
| | (0.120) |
| 52th Pct. of Inc. Dist. | 1.013*** |
| | (0.136) |
| 53th Pct. of Inc. Dist. | 1.060*** |
| | (0.134) |
| 54th Pct. of Inc. Dist. | 1.046*** |
| | (0.142) |
| 55th Pct. of Inc. Dist. | 1.157*** |
| | (0.130) |
| 56th Pct. of Inc. Dist. | 1.094*** |
| | (0.132) |
| 57th Pct. of Inc. Dist. | 1.155*** |
| | (0.126) |
| 58th Pct. of Inc. Dist. | 1.175*** |
| | (0.127) |
| 59th Pct. of Inc. Dist. | 1.060*** |
| | (0.136) |
| 60th Pct. of Inc. Dist. | 1.136*** |
| | (0.141) |
| 61th Pct. of Inc. Dist. | 1.185*** |
| | (0.137) |
| 62th Pct. of Inc. Dist. | 1.127*** |
| | (0.147) |
| 63th Pct. of Inc. Dist. | 1.163*** |
| | (0.143) |
| 64th Pct. of Inc. Dist. | 1.226*** |
| | (0.131) |
| 65th Pct. of Inc. Dist. | 1.105*** |
| | (0.133) |
| 66th Pct. of Inc. Dist. | 1.239*** |
| | (0.118) |
| 67th Pct. of Inc. Dist. | 1.194*** |
| | (0.132) |
| 68th Pct. of Inc. Dist. | 1.169*** |
| | (0.139) |
| 69th Pct. of Inc. Dist. | 1.201*** |
| | (0.148) |
| 70th Pct. of Inc. Dist. | 1.186*** |
| | (0.132) |
| 71th Pct. of Inc. Dist. | 1.273*** |
| | (0.142) |
| 72th Pct. of Inc. Dist. | 1.247*** |
| | (0.135) |
| 73th Pct. of Inc. Dist. | 1.327*** |
| | (0.133) |

| | | | | |
|---|---|---|---|---|
| 74th Pct. of Inc. Dist. | | | | 1.162*** |
| | | | | (0.147) |
| 75th Pct. of Inc. Dist. | | | | 1.264*** |
| | | | | (0.133) |
| 76th Pct. of Inc. Dist. | | | | 1.263*** |
| | | | | (0.124) |
| 77th Pct. of Inc. Dist. | | | | 1.341*** |
| | | | | (0.128) |
| 78th Pct. of Inc. Dist. | | | | 1.368*** |
| | 7 | | | (0.140) |
| 79th Pct. of Inc. Dist. | | | | 1.304*** |
| | | | | (0.126) |
| 80th Pct. of Inc. Dist. | | | | 1.312*** |
| | | | | (0.148) |
| 81th Pct. of Inc. Dist. | | | | 1.333*** |
| | | | | (0.120) |
| 82th Pct. of Inc. Dist. | | | | 1.354*** |
| | | | | (0.144) |
| 83th Pct. of Inc. Dist. | | | | 1.331*** |
| | | | | (0.140) |
| 84th Pct. of Inc. Dist. | | | | 1.366*** |
| | | | | (0.146) |
| 85th Pct. of Inc. Dist. | | | | 1.360*** |
| | | | | (0.129) |
| 86th Pct. of Inc. Dist. | | | | 1.429*** |
| | | | | (0.136) |
| 87th Pct. of Inc. Dist. | | | | 1.359*** |
| | | | | (0.131) |
| 88th Pct. of Inc. Dist. | | | | 1.411*** |
| | | | | (0.141) |
| 89th Pct. of Inc. Dist. | | | | 1.387*** |
| | | | | (0.137) |
| 90th Pct. of Inc. Dist. | | | | 1.439*** |
| | | | | (0.125) |
| 91th Pct. of Inc. Dist. | | | | 1.409*** |
| | | | | (0.131) |
| 92th Pct. of Inc. Dist. | | | | 1.420*** |
| | | | | (0.124) |
| 93th Pct. of Inc. Dist. | | | | 1.394*** |
| | | | | (0.131) |
| 94th Pct. of Inc. Dist. | | | | 1.430*** |
| | | | | (0.136) |
| 95th Pct. of Inc. Dist. | | | | 1.498*** |
| | | | | (0.137) |
| 96th Pct. of Inc. Dist. | | | | 1.503*** |
| | | | | (0.133) |
| 97th Pct. of Inc. Dist. | | | | 1.486*** |
| | | | | (0.141) |
| 98th Pct. of Inc. Dist. | | | | 1.510*** |
| | | | | (0.129) |
| 99th Pct. of Inc. Dist. | | | | 1.520*** |
| | | | | (0.133) |
| 100th Pct. of Inc. Dist. | | | | 1.655*** |
| | | | | (0.139) |
| Constant | 4.819*** | 6.336*** | 7.843*** | 8.027*** |
| | (0.416) | (0.199) | (0.115) | (0.337) |
| Observations | 746,093 | 746,093 | 746,093 | 746,093 |
| $R^2$ | 0.228 | 0.229 | 0.230 | 0.231 |

**Note:** Clustered standard errors in parentheses. + p < 0.1 * p < 0.05, ** p < 0.01, *** p < 0.001. Wave and country fixed effects are included in all regressions. Data: 2013 & 2018 EU-SILC.

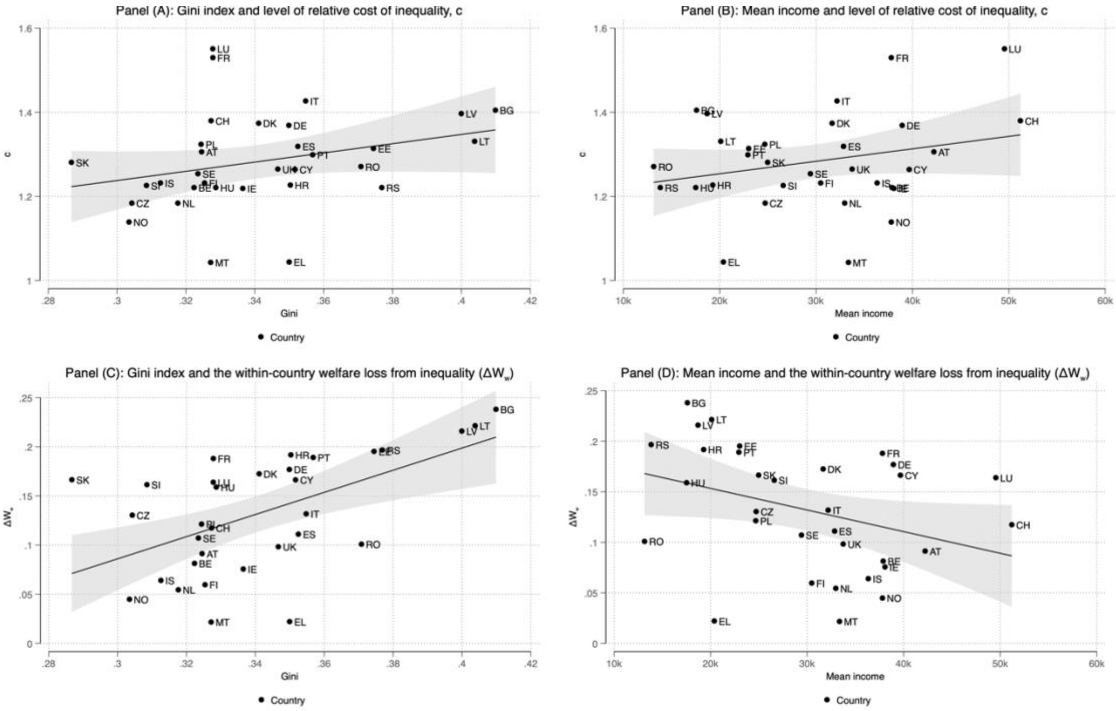
## Additional Figures

**Figure A1. Country-level estimates of the welfare loss from inequality (using the common-splines model)**




**Note:** Compared to Figure 4 in the main text, a pooled splines model (corresponding to the third row of Table 1) is used in this picture. That is, to estimate the shadow cost and wellbeing effect of inequality, a model based on pooled data from all European countries is used. The results are similar to those shown in Figure 4 in the main text. Data: 2013 & 2018 EU-SILC.

**Figure A2. Scatterplots of the welfare loss of inequality.**




**Note:** Panel (A) plots the estimated relative shadow cost of inequality against each country's inequality level as measured by the Gini coefficient. Panel (B) plots the relative shadow cost of inequality against each country's mean disposable household income level. Panel (C) and (D) repeat the same exercise in terms of the absolute wellbeing loss. All estimates are based on country-specific spline specifications (see equation (4) on page 5).